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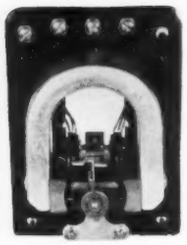

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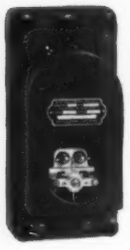

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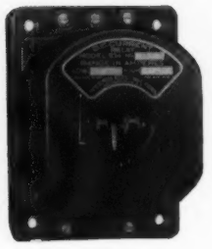

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We have a letter from a municipal subscriber who protests "a decided anti-municipal atmosphere permeating the pages of *Electrical World*." Nothing could be less intended, for we wish to be fair. We feel private ownership to be in the best interests of the public and say so. At the same time we know of several municipal operations that are well engineered and well managed. We know of some that are not. But there are also degrees of efficiency and management among private as well as municipal properties. Our earnest endeavor is to tell of good practices in engineering and management wherever they may be found; to be constructive and to serve engineers wherever they work. Some of our good engineering stories have come from engineers in city plants and we welcome municipal readers and their contributions to our pages.

●

A Range for Every Electrical Man—An outsider remarked: "If the electrical industry wishes to put over electric cooking, why doesn't it start at home? I wonder how many of the 350,000 electrical men have ranges in their homes?" We wonder also. We know a great many who have not. A good opportunity for constructive self-analysis.

●

Don't Dam Production—The Columbia University Commission on Economic Reconstruction states that prosperity will arrive when society utilizes its productive capacity to the full value. Those engineers and managers questioned by the board stated that a 90 per cent gain would be had if present management and equipment in industry were brought up to date. Limitation of output and artificial levers to raise prices are seen as illusions. A little thought will show that this report means a greater electrification of industry—rebuilding in an old market.

●

We regret that through a misunderstanding the name of H. N. Kalb of the Pacific Gas & Electric Company was omitted as the author of "Telephone Interference Reduced by Impedor Application" in our March 31 issue.

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April 28, 1934

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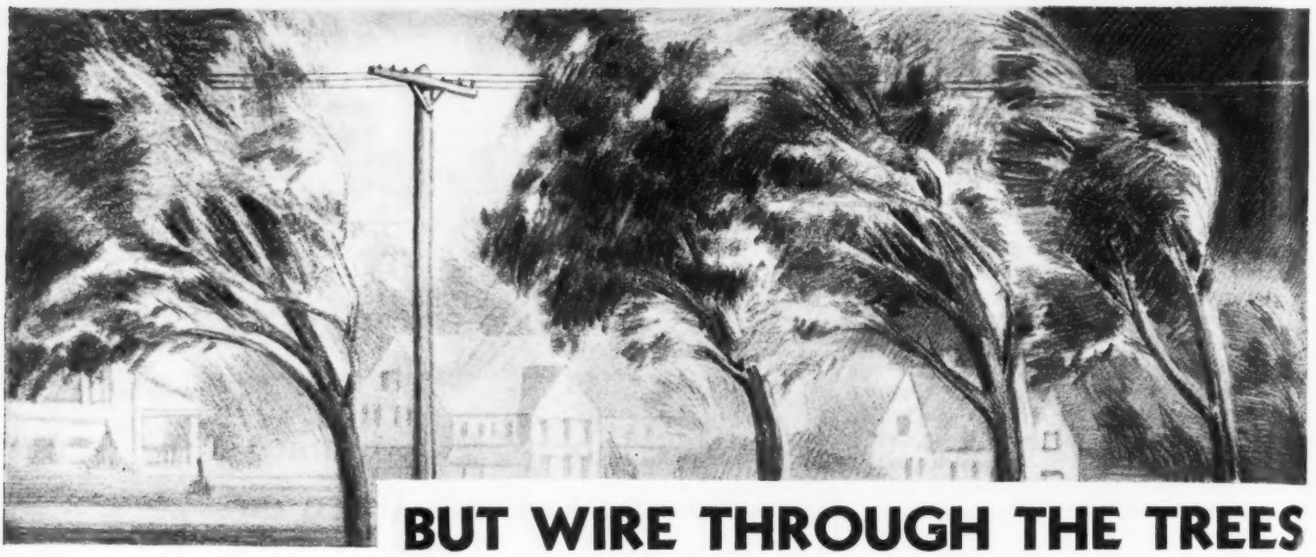

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ELECTRICAL WORLD

Established 1883—McGraw-Hill Publishing Company, Inc.

for the Week Ending

April 28, 1934

L. W. W. MORROW, *Editor*

Electrical Contractors Tackle a Big Job

After nine months of arduous work the electrical contractors have their code. The President has just signed it. On Monday next this branch of the industry begins its adventure in self-government. The operation of this code will be watched with close attention by all electrical men.

The contractors are not inexperienced in organization. For more than thirty years they have maintained a continuous industry association and an aggressive leadership in the advancement and defense of their interests. But they have had a difficult condition to cope with, in that they have endeavored to weld together a small number of large engineering and construction firms, doing a national business, and a large number of small wiring contractors, engaged in local installation and repair work. There has never been accurate knowledge of how many small contractors there are, nor what they are doing. So the development of higher economic and ethical standards in this branch of the industry has always been handicapped. The majority of small contractors, being local minded, would not join a national association and there has been a steady flow of men in and out of the wiring business, year by year, subject to no influence except the local inspection.

Now, under the code, there is to be an integrated industry, with a clear definition of field and function. Vital statistics will be reported monthly. A minimum wage of 75 cents per hour is set for skilled labor, the first to be established in any supplemental construction code. Hours of labor and conditions of employment will be arranged by mutual agreement locally or by regions.

The electrical contractors' code will not apply to telephone or telegraph, light or power, signal or fire systems, installed by utility or service companies as part of their own systems. It will not cover manufacturing or assembly in the manufacturer's plant or servicing or repairing of electrical apparatus by the manufacturer or repair shops. It will not embrace repairs to existing installations by an owner or tenant, except that men employed on new work or not regularly employed for more than six months must be paid the full contractor's scale.

It is believed that this latter provision will bring a large increase in industrial work to the contractor that has heretofore been done by the plant electrician. If so, it will do much to help this branch of the electrical industry toward recovery and relieve it from so large a dependence upon new building. The enforcement of this provision may be difficult and will probably not be long in waiting for a test. In fact, the administration of the code itself will call for an extremely complicated work of organization and education. But if it can bring order and better business methods to this vast, scattered trade it holds promise of great benefit to the contractor. And this will help the rest of the industry as well.

Lehman Bills, Passed, Predominantly Political

Before trying to prosper and be exceptionally good the utilities in New York state are manifestly destined for an exciting life in the months ahead. Governor Lehman's bills, parried by the Senate and Assembly for weeks, suddenly popped out, all passed and signed, just because some one rediscovered in Washington files a letter or two that seemed to incriminate New York legislators. A partisan of the utilities can find

plenty to bewail and criticise in the bill authorizing municipal competition and in another setting the ominous level of 5 per cent as an adequate return in emergency rate rulings. On the other hand, the advocates of government ownership gain comfort in the bills requiring utilities to bear directly certain of the costs of regulation and the still-pending measure dictating public bidding on large contracts.

More disconcerting, however, than the details of these new measures is the sad commentary the program affords on representative government and its departures from calm, logical and rational procedure. Without a doubt the mass of the people are not in accord with the hidebound conservatism that held sway while the utility group reputedly held the legislative reins. If, on the other hand, half of the consequences of the batch of bills now to go into effect could be laid before the intelligent middle class of voters they would never, in "town meeting," have gone so far.

The utilities will survive this new horde of restraints. Commission regulation will survive this reversion to discredited regulation by legislation. Electricity holds too much vigorous promise to whimper and whine about its bonds—either the fetter kind or the letter kind. But for those who have only the welfare and progress of a fundamental natural resource and industry at heart it is disappointing that the executive talent of the business is to be forced to fritter away its efforts on prolonged investigations and purely defensive measures. It should better be unleashed, to devote itself unrestrainedly to the new great stride in making electricity in home and industry what it was destined to be.

Pole Settings and Strengths Need Critical Analyses

Economic and practical studies of poles and pole replacements show opportunities for major economies. For example, there is much to be gained from studying soil mechanics and the minimum adequate depth to which poles should be set. The last foot of a 5-ft. hole costs as much as the first four and may not be necessary. One engineer has built lines for some years using 30-ft. poles set 4 ft. in the ground and has experienced little trouble.

Also it pays to investigate pole strength requirements. This involves determining the percentage of protected poles, the number supported by services, the economic use of guys, the probability of maximum stress, the ordinary and emergency loads on the poles, the probability of getting maximum strength in the wood and the variation in size and strength to be expected in a given lot of poles. When it is remembered that poles make up a large percentage of distribution cost, reason indicates the avoidance of rule-of-thumb methods or the use of standard tables that were set up on a play-safe basis. Millions of dollars may be saved in pole buying and pole replacement by use of performance records, analysis of pole applications and good engineering.

Wise Penny Economies Bring Dollar Savings

Engineers in industrial plants and in utility distribution systems are responsible for a host of small items of purchase, of operation and of maintenance. Their points of view must be devoted to saving a penny here and there on each item so that the multiplication of those pennies may become dollars. The pennies saved must also be viewed with the imagination necessary to valuate their effect upon the service and the human elements of the enterprise.

In the approach to this work several things are essential. There must be records, but these must be developed within definite economic limitations. There must be standards of construction and of practice, but the principle of standardization can be carried beyond reason and become a handicap. There must be a staff of men with knowledge and with imagination so that the work is done well, yet with an intelligent questing for better things and better ways. There must be recurrent economic investigation of practices and a follow-up so that new ideas and new equipment are introduced and checked for results. Tradition, rule-of-thumb, a general acceptance of past practices and a lack of knowledge of new developments —these cost industry millions of dollars a year.

In this labyrinth engineers will find the first approach to be based upon cost information. Take total costs, next major items of costs and, lastly, small items of cost. Both fixed and operating costs must be considered. Survey these costs, study what produced them, check alternative practices and equipment for their costs. This field of penny engineering is dollar engineering of major magnitude when viewed as a whole.

Why E.E.I. Plans a More Liberal Policy for Technical Committees

By GEORGE B. CORTELYOU
President Edison Electric Institute

DURING the past several months I have received from a number of sources expressions to the effect that the men in the electric light and power industry, particularly among the engineering forces, are feeling a lack of sufficient opportunities for contact with men in like positions and engaged in similar work in other companies. They feel themselves isolated from their fellows and unable to keep in touch with what is going on elsewhere.

When the Edison Electric Institute was organized, a little more than a year ago, it was recognized that it would be much easier to build up a committee structure from time to time as conditions warranted than it would be to trim down one that had been started too elaborately. The operating committee, therefore, very wisely, in my opinion, decided to organize only a few small committees. This necessarily limited the opportunity for outside contact through committee work to a small percentage of the men doing important work in their companies.

At a recent meeting of the operating committee a number of the technical committee chairmen commented on this aspect of the present committee organization. They were instructed by the operating committee to canvass the situation further and submit definite recommendations toward correcting any deficiency. It was the sentiment of the meeting that at the present time conditions had changed sufficiently to warrant a somewhat more liberal policy in the matter of representation on committees. Many of the operating companies are large and there are many younger men with important responsibilities who should be allowed the opportunity of growth and development which comes from committee work.

The value of maintaining contact with industry organizations in the various sections of the country was also discussed. The technical committee chairmen were asked in submitting their recommendations to the operating committee to give consideration also to practical means of keeping in touch with the work of similar committees in state or regional electric utility associations. This relationship with regional committees is of particular interest with respect to the engineering and sales committees.

In considering the question of enlarging somewhat and otherwise improving the committee organization of the Edison Electric Institute, the operating committee will be guided by the principle of undertaking those steps which promise the most benefit with a minimum of elaboration and expense. It is recognized that committees must not be allowed to become topheavy and a burden upon member companies, but at the same time the opportunity for benefiting by committee work should not be unduly limited.

Motor-Starting-Current Steps Based on Connected Load

By THOMAS J. BROSNAN

Electrical Engineer
Buffalo, Niagara & Eastern
Power Company

Of significance to both the industrial motor user and the utility service department, the author offers a discussion of the new starting-current rules that have been adopted by the operating companies of the Niagara Hudson Power System. Experience with liberalized rules by these companies for well over two years has shown a fairer over-all result for the power user, the electrical manufacturer and the utility company.

A RATHER interesting check has been made in one of the large cities on the Niagara Hudson Power System to determine what would have been the effect on the type of starters required for all of the motors in the city had recently adopted motor-starting rules been in effect in the past. It was found that more than 90 per cent of the 10-hp. motors in the city could have been started across-the-line and that this percentage decreased rather gradually for the larger size motors, so that even for 50-hp. motors almost 70 per cent of the total number of such size motors in the city could have been started across-the-line.

Inrush of low power factor starting current that takes place the instant that a motor is connected to the line results in a sudden drop of voltage in the entire distribution system in the immediate vicinity. The magnitude of this sudden drop in voltage depends on the magnitude and power factor of the starting current and the capacity of that section of the distribution system in the immediate vicinity of the motor.

Motor's own rating not the best criterion

Sudden change in voltage resulting from the inrush of starting current will be greatest and have the most serious effect on any load supplied by the same service drop that supplies the motor. The next most serious effect will be on other loads supplied by a different service drop but by the same transformer that supplies the motor. It will have less effect on loads supplied by the same primary feeder but through different transformers. This matter has been emphasized to show that the consideration of disturbance caused by motor starting is of growing importance with the rather rapid development today of combined light and power systems where both power and lighting loads are supplied by the same transformers and very often by the same service wires.

It is evident from the foregoing that it is necessary for an electric utility company to regulate the starting of motors in order to insure proper quality of service to all customers.

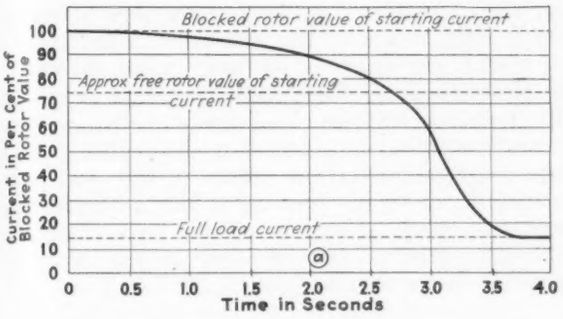
It has been almost a universal practice of such companies in the past to limit the starting current of motors on the basis of the horsepower rating of the motor itself. For example, it has been very common to require the use of reduced voltage starters for all motors 10 hp. and larger. It is evident, upon consideration, that while the horsepower rating of the motor is a gage of the magnitude of the starting current, it is in no way a measure of the ability of the distribution system to supply the required starting current without a serious change in voltage. The latter is entirely a function of the system itself. As an example, it would, in most cases, be perfectly satisfactory to start a 25-hp. motor across-the-line in the plant of a large manufacturing company where the 25-hp. motor is only a very small fraction of the total electric load, but across-the-line starting of that same size motor in a small store where the motor itself represents practically the entire load of the customer would undoubtedly result in voltage disturbance that would impair the quality of service to all customers in the immediate vicinity.

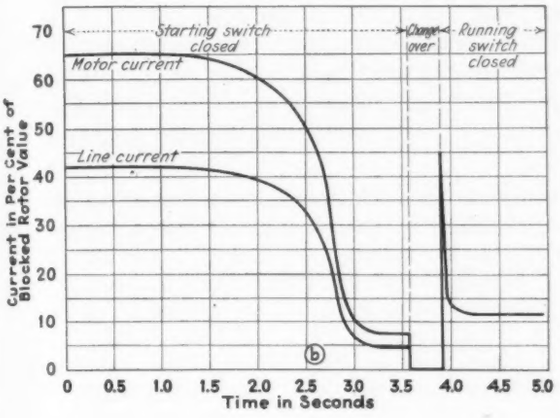
About two years ago the operating companies of the Niagara Hudson Power System established a new set of motor-starting requirements worked out on the basic principle of limiting the starting current of the motor on the basis of the capacity of the system to handle that starting current at the particular location where the motor is to be installed.

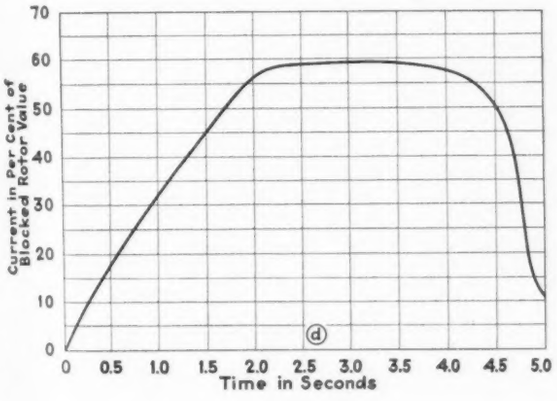
Other connected load fixes permissible starting current

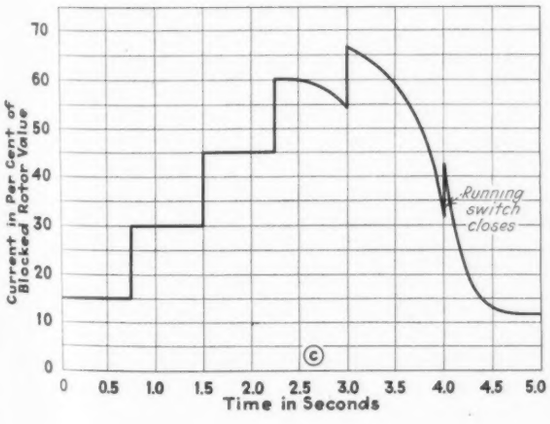
One difficulty of establishing limitations on such a basis is the working out of some simple method of determining the capacity of the distribution system in the vicinity of any particular customer. It was decided that the customer's connected load would be a satisfactory gage and one that would also be readily available.

The starting current limitations themselves have been worked out in such a way as to avoid placing any limitation on the total starting current that may be taken by a motor. They limit only the magnitude of the current that may be taken on each step in building up to the


Blocked rotor value of starting current
Approx free rotor value of starting current
Full load current
Current in Per Cent of Blocked Rotor Value
Time in Seconds
a







total value of current required to start the motor. It has been proved by numerous tests that within reasonable limits the rate at which the voltage changes is more important than the magnitude of the change in determining the annoyance produced by such a variation. An instantaneous change of 4 or 5 volts will result in a flicker of incandescent lamps, but a gradual change of even 12 to 15 volts will, in most cases, not be noticed. Therefore, the basic principle on which the rules have been worked out has been to limit the rate of building up the starting current rather than placing any limitation on the toal value of the starting current.

The following quotation from the "Specifications for Electrical Installations" of the Niagara Hudson Power System shows how the basic ideas mentioned in the preceding paragraphs have been incorporated into a set of rules:

The accompanying table states in terms of a customer's total installed kw. (motors, lights, etc.), including the motor under consideration, the maximum allowable increase in current on the line side of the motor-starting device at any one instant during the starting operation. This specification does not limit the total current that may be taken by the motor in starting, but it may require that the total be built up gradually, or in steps which do not exceed the value determined from the table.

A motor may be started "across-the-line" if its total starting current does not exceed the limitations given in the following tabulation. Compensator type starters may be used for motors requiring higher starting currents provided the current taken on either the starting or the running step and measured on the line side of the starter does not exceed limitations. Where still higher values of starting current are required it is necessary to use a starter which will increase the current gradually or in steps to the value required to start the motor and without breaking the circuit during the starting operation. When a step type starter is used an appreciable time must be allowed on each step.

Starting limitation per step

1. Primary and Secondary Service (Except Networks):
   (a) *Three-phase, 220-volt motors ..... 80 amp. plus 2.5 amp. per installed kw.
   (b) *One-phase, 220-volt motors ..... 45 amp. plus 2.25 amp. per installed kw.
2. Low-Voltage A.C. Networks:
   (a) Three-phase, 220-volt motors ..... 130 amp. plus 1.25 amp. per installed kw.
   (b) One - phase, 220-volt motor ..... 115 amp. plus 1.0 amp. per installed kw.
3. One-Phase, 110-Volt Motors Up to ½ Hp.:
   (a) Motors up to and including ¼ hp. .... 20 amp.
   (b) ⅓-hp. motors .... 25 amp.
   (c) ½-hp. motors .... 34 amp.

*If the rated voltage of the motor is higher than 220 volts, the allowable current should be reduced in proportion. For example, if the motor voltage is 440 volts, the current indicated above should be divided by 2; if 2,200 volts, should be divided by 10, etc.

The method in which these rules can be used so as to permit the starting of any type of motor is best illustrated by consideration of the starting current characteristics of motors with various types of starters as shown in the accompanying illustrations.

Typical starting current characteristics of squirrel-cage motors

(a) Across-the-line motor—This type of starting is permitted by the rules whenever the blocked rotor value of the motor-starting current does not exceed the step limitation in the rule.

(b) Motor with compensator starter having 65 per cent tap—This type is permitted when the current on the line side of the starter does not exceed the step limitation upon the closing of the start-switch or the change to the running switch.

(c) Step-type resistor starter with squirrel-cage motor.

(d) Compression type resistance starter with squirrel-cage motor—Both these types of starters are permitted under all conditions because they accomplish the definite purpose of the rules by limiting the rate at which the starting current is built up to the value required to start the motor.

Apply Reactive Power for Line-Loss Control

Rather than discuss power-factor correction and the benefits that it brings to inductive-load users and to energy suppliers alike, Mr. Bolsterli would have reactive power as a clearer, more reasonable substitute.

By A. A. BOLSTERLI
Products Protection Corporation, New Haven, Conn.

IN DEALING with problems associated with power-factor correction it is more convenient to figure in terms of reactive power than in terms of power factor for several reasons. For one thing, reactive power possesses a measure of tangibility that power factor as a mere numerical ratio completely lacks. Like watt power, it causes losses in transmission and is metered much like real power. If it were not for the use of the concept of power factor to the almost complete exclusion of reactive power, and the consequent mystification of the subject, there would be a great deal less resistance to the inclusion of reactive power in rate schedules and the application of corrective equipment. It is obvious, psychologically, that the acceptance of capacitors, for example, is much easier to obtain if it is explained that they supply reactive power, the need for which is as real in any plant as that for watt power.

The reactive approach also simplifies calculations and makes them more transparent. The customary method of determining the extra losses due to poor power factor consists in figuring the losses due to the total current for both the corrected and uncorrected power factor and taking the difference. In the method proposed use is made of the fact that the loss caused by the reactive component of current, i.e., the loss ascribed to reactive power, is independent of the watt current and equal to the product to the square of the reactive current into the resistance of the line. The reactive power is determined simply by adding the reactive powers of the apparatus connected, whereby it is useful to remember that the reactive power of induction motors at full load is not more than 25 to 40 per cent above that required when the motor is idling. Even though the load condition is variable or indefinite, the spread in the reactive power is nevertheless comparatively narrow.

If P_r is the reactive power in kvar. transmitted, E the voltage in volts, A the copper section of conductor in circular mil, the loss W in watts per 100 ft. of one-way length of either a three-phase, three-wire or two-phase, four-wire line is given by:

$$W = 11.75 \frac{P_r^2}{E^2 A} \cdot 10^6$$

This formula, which is based on a resistivity of 11.75 ohm/circ.mil-ft. (copper at about 50 deg. C.) is translated into an alignment chart in Fig. 1 for 220 and 440 volts. If the size of conductor and the reactive power transmitted are known, the losses per 100 ft. can be read directly from the chart.

The dotted line in Fig. 1 exemplifies the following case: 40 kvar, transmitted at 220 volts through a three-phase, 3-wire line of No. 4/0 copper section cause losses of 300 watts per 100 ft. of one-way length. If line is 300 ft. long losses are consequently 900 watts.

This loss can be eliminated entirely by installing static condensers of a total kva. rating equal to the lagging reactive power consumed, which in terms of power factor means correction to 100 per cent P.F. In the usual case only a part of the reactive power is compensated. If in the above example a 20-kva. condenser is connected at the end of the line the reactive power transmitted is reduced to 20 kva. and the corresponding loss is

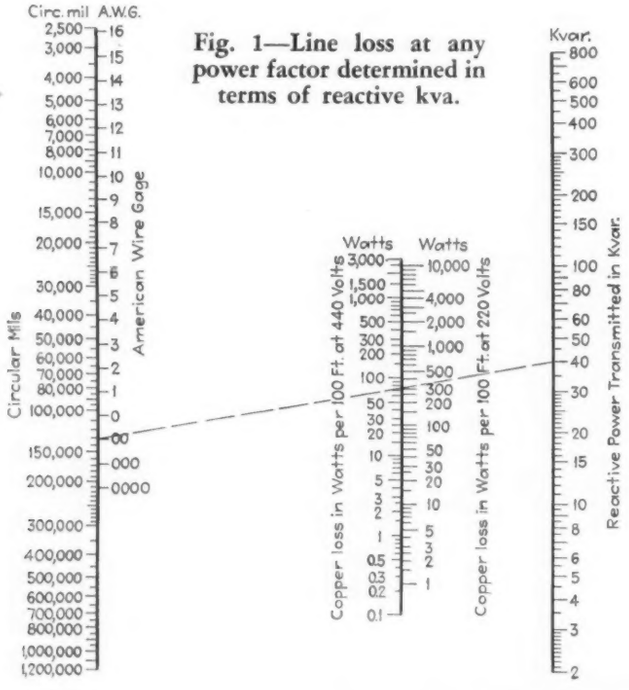


Fig. 1—Line loss at any power factor determined in terms of reactive kva.

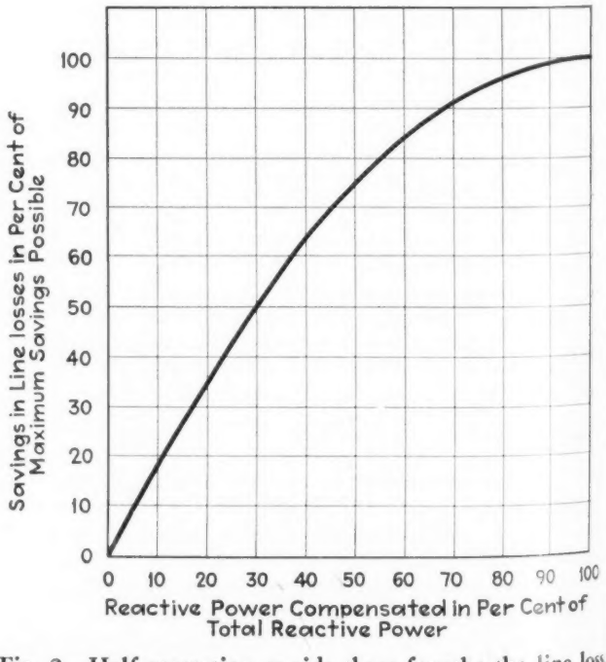

Savings in Line losses in Per Cent of Maximum Savings Possible
Reactive Power Compensated in Per Cent of Total Reactive Power

Fig. 2—Half-correction avoids three-fourths the line loss

read from the chart as 75 watts per 100 ft. The savings in losses through correction are therefore 675 watts for a 300-ft. line.

In this connection the graph shown in Fig. 2 is useful. Taking the copper losses caused by the total reactive power as 100 per cent, it shows the percentage savings in losses that can be effected, in function of the percentage of reactive power that is compensated by condensers or other corrective apparatus. Applied to the example cited, it confirms the result already obtained, namely, that compensating half the reactive power affords 75 per cent of the maximum saving possible.

Daylight Yields to Photo-Cell Control

Four motor-operated skylight louvers in a Carolina post office are manipulated automatically by individual electric eyes to give glareless illumination for sorting room.

East or west, the sun is made to give uniform intensity over the room and over the day.

By E. H. VEDDER

Supply Engineering Department,
Westinghouse Electric & Manufacturing Company, East Pittsburgh

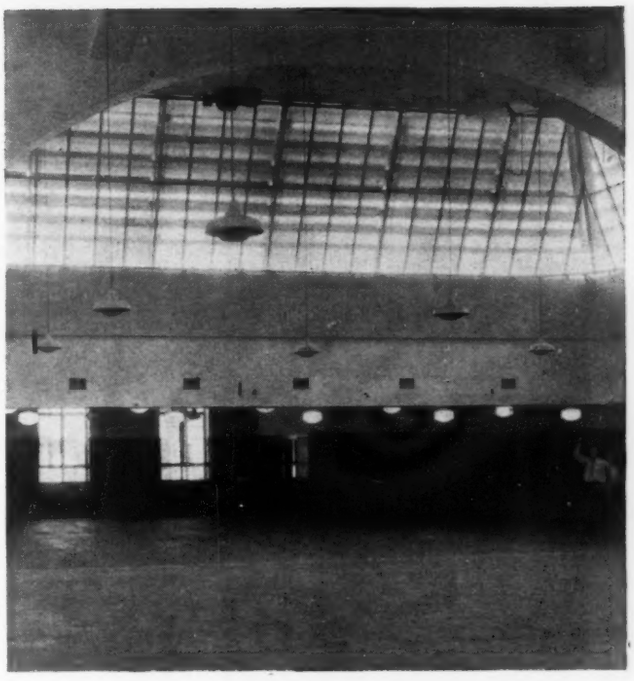
MAKING use of sunlight for lighting purposes for high intensities without glare has always been a difficult problem. It has also been a problem to maintain a relatively constant illumination in the work area unvarying with weather and time of day. High-intensity glareless lighting is particularly desirable in post office sorting rooms. The recently completed High Point, N. C., post office presents a unique solution of this problem. This post office has a four-sided skylight which has windows only on the four sides and none on the top. The skylight is located directly above the sorting floor and is about as large as the floor itself, being 60x80 ft. Windows in the sides are continuous and are of diffusing glass.

Directly outside the windows on each of the four sides is an aluminum louver or shutter which is motor-operated, and its function is to assume such a position that a predetermined intensity of light will reach the sorting floor. The position of the louver to obtain this result is dictated by the "Photolux" control.

Individual control for each louver

Each of the four louvers has its own "Photolux" control, which consists of a phototube or electric eye mounted just inside the skylight near the ceiling with a control cabinet near floor level. The control unit contains an amplifier which is operated by the phototube and also a number of auxiliary control relays. The amplifier tube energizes a D'Arsonval type relay with a front and a back contact.

When the light on the phototube increases, the amplifier increases the relay current and the relay closes its front contact. Through auxiliary relays the line starter closes and the louver motor runs in such a direction as to close the louvers and decrease the light. The louver continues to move until the light has been reduced to its original value, when the louver stops until the light again changes. If the light decreases, the motor and louver are run in the opposite direction so as to admit more light and thus reach a balance again on the working area.



Postal sorting room has uniform daylight from photo-cell-actuated skylight louvers

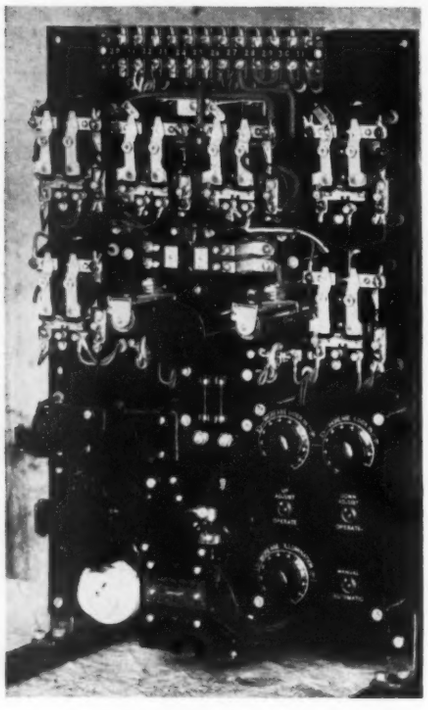
Provisions are included in the individual units for manual control if desired. Complete anti-hunting arrangements are provided to prevent overtravel. Time-delay relays prevent incessant operation on light changes of very short duration.

The louvers are prevented from traveling beyond the limit by high run limit switches direct connected to the louver motors. These limit switches have three switches in each, one of which is for the "down" or lower louver position, one for the "up" or upper louver position, and the other is an intermediate point for a special purpose described later.

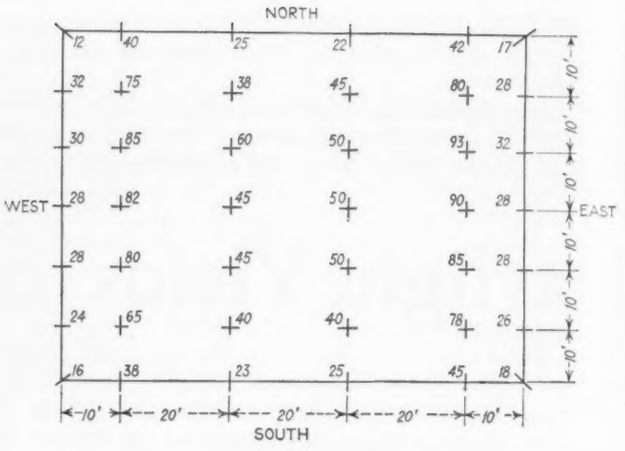
Master controller closes louvers at night

In addition to the control described for each louver, there is a "Photolux" master controller mounted on the roof of the building. Its purpose is to determine the range of operation of the louvers. During the day the

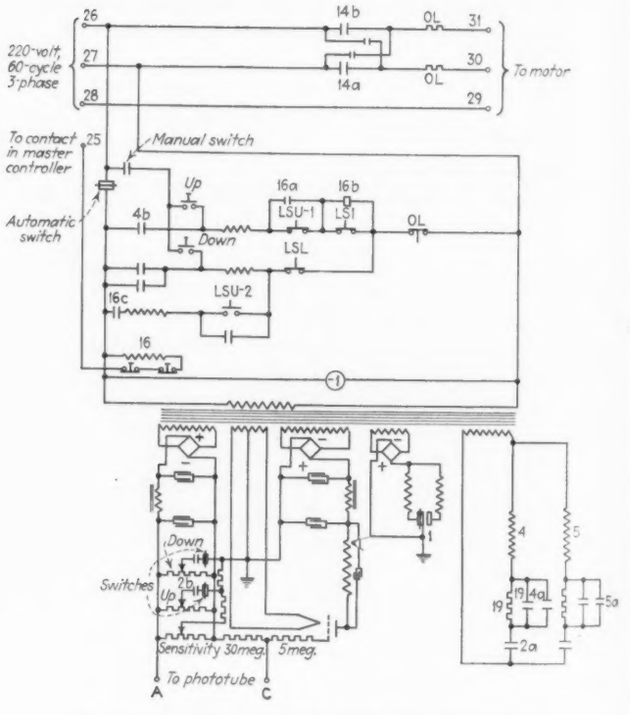
Louvers are on the outside of the skylight



Photolux control unit is mounted in cabinet on wall of sorting room



Louvers give this distribution in foot-candles during an early forenoon



Limit switches control position of louvers

Limit switch contains three units, LSL, LSI and LSU, which operate, respectively, the "lower," "intermediate" and "upper" positions of the louvers. Briefly, the elemental sequence is as follows: Assume louvers in extreme down position, which means master control contact is closed and relay No. 16 is energized. Then

Relay—

1. Controlled by amount of light on phototube.
2. Auxiliary relay operated from contacts of relay No. 1 to initiate "up" movement louvers.
4. Operated after time delay caused by thermal buttons 19.
14. Picks up due to operation of contact 4-b.
16. Already energized by master controller.

Motor—Contacts 14-A and 14-b close to operate motor to open louvers.

1. More light brings relay 1 to central position, de-energizing relay 2.

master controller allows the louver to operate only between the lower and intermediate limit switch positions. At night the master controller causes all louvers to proceed to the maximum "up" position or upper limit switch, which essentially closes the louvers in the "up" position. In the morning, when the master controller operates, the louvers again must operate between the lower and intermediate positions. This feature is provided so that when it becomes too dark at night the louvers will close and force the employees to turn on the individual lights on the sorting cases and the overhead general lighting which is not automatically controlled.

Distribution of light intensity throughout the sorting floor during early morning is unusually even over the area of 60x80 ft., as seen in the accompanying illustration.

The control equipment maintains a very constant illumination throughout the day from early morning to late afternoon. The total variation on the floor is only about one-tenth of that outdoors in per cent even with the sun shifting from east to west.

Grooved Collector Rings Save Brushes

By W. B. FISK and T. FORT

Assistant Inside Plant Engineer, Brooklyn Edison Company — Westinghouse Electric & Manufacturing Company

Helical grooves greatly reduce unequal current distribution between field brushes.

Half as many brush replacements and one-third the former cost of maintenance are reported among the tangible benefits.

FIELD tests indicate that grooved collector rings have solved one of the serious design and operating problems in connection with large synchronous apparatus. This type of collector ring was perfected in the Westinghouse Research Laboratories and has been successfully applied in the Hudson Avenue generating station of the Brooklyn Edison Company, where operating data have been carefully observed.

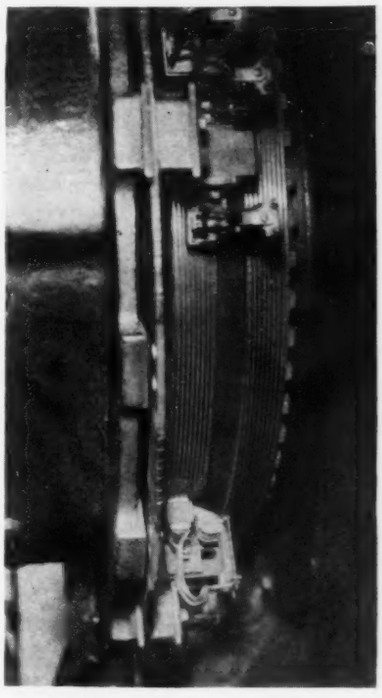
Theoretically the various brushes riding on a slip ring should divide the field current between themselves with reasonable uniformity. In practice such has not always been the case with some of the larger machines. Some of the brushes and shunts became alarmingly hot. The same brushes were not always the hot ones, so there was no consistency of performance which would single out any individual brushes as being defective. Sometimes machine shutdowns were threatened due to this selective overloading of the collector ring brushes. These troubles apparently become more severe at high peripheral speeds.

Laboratory set-ups were made and extensive research carried on three or four years ago by the Westinghouse Electric & Manufacturing Company to determine the exact action which goes on in conducting current to the slip rings of synchronous machines.* It seemed reasonable before the investigation to assume that the current flowed from a countless number of points on the smooth face of the brush to the collector ring. However, it was found that only three to six minute spots were conducting almost all of the current where light pressure was applied to a collector ring brush. More startling was the revelation that even with increased pressure on the brush the number of these minute active current-carrying spots was only increased to between 50 and 100. These spots conducting current to a normal slip ring constituted a maximum of about 3 per cent of the polished surface of the brush.

Carbon's negative coefficient detrimental

The current-collecting spots probably change around over the surface of the brush, so that if a brush is normally loaded an even distribution of temperature is obtained throughout. In an overloaded brush these spots may collect in one section long enough to make it hotter than the remainder of the brush. The negative coefficient of resistance in the carbon brush causes the current through the hot section to increase. The whole brush will become overheated and carry more than its share of the total field current.

Should a brush twice the width of the slip ring have been practical, this trouble could have been eliminated by a method of moving the brush face back and forth across the slip ring. Such a scheme was of course out of the question. Research engineers determined that an action of this type could be simulated if helical grooves were cut in the face of the slip ring. Each rotation of the shaft would continuously shift sections of the collector ring across the brush. The current could only instantaneously select points through which to flow. This type of collector ring could be applied to machines in service with very little difficulty. It involved no change in generator shaft design. In the laboratory two years ago it appeared an ideal solution and remained only to be tried in service.



50,000-kw. alternator has 40-in. collector ring with helical grooves

Grooves are about $\frac{3}{8}$ in. wide and $\frac{1}{8}$ in. deep with $\frac{1}{4}$ in. pitch of spiral.

In the spring of 1932 the smooth steel collector rings on a 50,000-kw. turbo-generator in the Hudson Avenue station of the Brooklyn Edison Company were replaced with rings of the helically grooved type. This generator has a slip ring 40 in. in diameter with a peripheral speed of 12,570 ft. per minute and is provided with sixteen $1\frac{1}{4}$x$1\frac{3}{4}$-in. brushes per ring with a current density of 24.5 amp. per square inch at full load (smooth rings). The grooved rings installed have a single helical groove $\frac{1}{8}$ in. wide, $\frac{1}{8}$ in. deep with a pitch of approximately $\frac{1}{4}$ in. In addition each ring has a series of small projections on one side which serve to improve the circulation of air around the rings.

Operation of the grooved rings was very satisfactory from the start and all of the troubles due to selective loading of brushes and excessive heating were eliminated. After several hundred hours of successful operation it was decided to install similar rings on a larger machine on which brush trouble had been experienced.

*See paper entitled "The Application of the Helical Groove to Slip Rings and Commutators," presented before winter convention A.I.E.E., New York, January 26-30, 1931.

Two 110,000-kw. cross-compound turbo-generators are installed in this station and are essentially duplicate machines. They have ring peripheral speeds of 12,010 and 12,730 ft. per minute respectively and are provided with sixteen 1x1½-in. brushes per ring with a current density of 29 amp. per sq.in. at full load (smooth rings).

Grooved rings essentially the same in construction as those used on the 50,000-kw. machine were installed on the unit having a ring speed of 12,010 ft. per minute. The rings on the other unit were not changed and the performance of the two types of rings under similar operating conditions was compared over ten months.

Uniformity in current distribution results

Close observation was made of the selective loading of brushes on these two machines, this having been the most serious point of difficulty. With smooth rings readings of voltage drop across the brush shunts indicated that frequently 20 per cent of the brushes were carrying 80 per cent of the total field current of the generator. At times individual brushes carried as much as 40 per cent of the total field current, and other brushes on the same ring carried practically no current.

In comparison, brushes on the unit having grooved rings operating under the same total field current divided current quite uniformly. A number of checks indicated that the maximum current carried by an individual brush was less than 10 per cent of the total current per ring (sixteen brushes per ring).

Comparative temperature measurements were made by drilling holes through test brushes and inserting a thermometer with a very small clearance between the thermometer bulb and the surface of the ring. A series of tests on the smooth rings indicated temperatures ranging between 170 and 180 deg. F. with a field current of 500 amp. Tests on the grooved rings at the same field current indicated a temperature of 115 to 127 deg. F.

No loss in contact area by grooving

It is of interest to note that the decrease in effective brush contact area caused by the grooving of the rings and the corresponding increase in current density had no detrimental effect. This experience is in accord with the conclusions reached from the laboratory tests that a very small per cent of the brush area is effective on a smooth ring. Brush life has been increased.

The following tabulation indicates comparative performance of the grooved and smooth rings over a period of approximately ten months. In all cases standard soft graphite brushes of the high-speed slip-ring type were used:

	110,000-Kw. Turbo-Gen. with Smooth Collector Rings	110,000-Kw. Turbo-Gen. with Grooved Collector Rings
Best brush pressure	3½ lb. per brush	2½ lb. per brush
Hours operation	4,018	4,068
No. of brushes used	150	85
Labor, per cent	100	23
Total expense, per cent	100	30

Aside from the lower operating costs for the grooved rings, of major importance is the elimination of the slip ring and brush problem as an important item in the reliability of large units.

As a result of this experience similar rings were installed on the second 110,000-kw. unit at Hudson Avenue and after an operation of 1,300 hours the results have been identical to those previously obtained.

ELECTRICAL

Portable Generating Unit Halves Clay Pit Pumping Costs

By M. BRASSEUR
Industrial Sales Engineer
Westinghouse Electric & Manufacturing Company, Chicago

Brick companies resort to pump houses containing 25 to 50-hp. pumps, motor operated, to pump out the water that collects in their clay pits from rain and seepage. Their own power houses usually supply the operating current. This year the Illinois Brick Company of Chicago found it necessary to shut down its plants temporarily and to keep its pits dry was faced with the necessity of starting up the boilers at a cost of $50 to $60 a day, including initial warm-up period, labor and fuel. It was decided to procure a portable gasoline-generating unit capable of full-time operation which could be moved on a truck from pit to pit as needed. This installation cut the pumping cost to only about $30 a day.

Truck-mounted portable generating plant is readily available

The generating plant is a Westinghouse type SK generator, rated at 300 kw., 230 volts d.c. at 1,200 r.p.m., powered by a Hercules flyball governed gasoline engine. The plant was placed in 24-hour service on May 1, 1933, and was run continuously without trouble in approximately three-month periods, between which the motor was overhauled (valves ground, etc.) at a total repair expense up to December 1, 1933, of only $150. At full load the engine uses approximately 100 gal. of gasoline and 1½ gal. of oil per day. Total cost to the brick company, including labor, gas and oil, is about $30 per day, or a saving of $20 to $30 per day over operation of its steam plant. The unit also gives the advantage of operation at full capacity within fifteen to twenty minutes after arriving at any of the company's ten plants, thus eliminating one-half to one day warming-up periods of the steam plants, with a minimum amount of attention, since one man can move and put the set in operation, after which no care is necessary except to replenish the fuel supply periodically. The truck is equipped with 125 ft. of cable for connecting generating unit to the pump motors.

PRACTICE IN INDUSTRY

Savings to Amortize Outlay for Capacitors in 18 Months

On the basis of power bill savings for the first two months after installing a 90-kva., 4,600-volt General Electric "Pyranol" capacitor, the Richman Brothers Company, Cleveland, clothing manufacturers, pay for the equipment out of savings in about eighteen months. The power factor was raised from 72 to 90.7 per cent and the power bill was reduced by $110. The load averages from 180 to 350 kw. The 4,600-volt supply is stepped down at the plant to 230 volts. The use of 4,600-volt capacitors and oil-filled cut-outs rather than 230-volt capacitors and oil circuit breakers for connecting the capacitors to the line reduced the cost of installation and made possible a more attractive return on the investment.

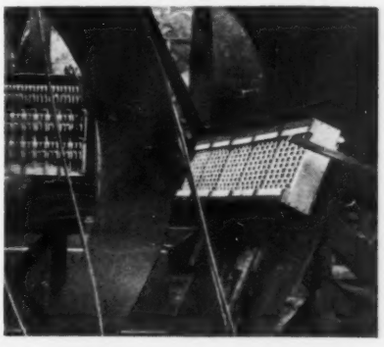
Welding Stress Relieved by Heating in the Field

By W. F. METZGER
Engineer H. O. Swoboda, Inc., Pittsburgh, Pa.

Intense local application of heat during the welding process and the succeeding natural cooling usually leave a welded joint with an accumulation of internal stresses. If the joint is in a pipe that will be subjected to very high pressures these stresses may be very dangerous and it becomes necessary to relieve them before the joint can be said to be finished. Stress relief is accomplished by heating the part to a certain temperature, "soaking" for a specified time at that temperature and then cooling at a prescribed rate of heat decrease. In the cases of the penstocks at the Kanawha River project near Charleston, W. Va., this stress relieving is done by the application of electric heat, as is shown in the accompanying illustrations of the method at work on the smaller, 14-ft., penstocks. The larger, 30-ft., pipes are treated in the same way.

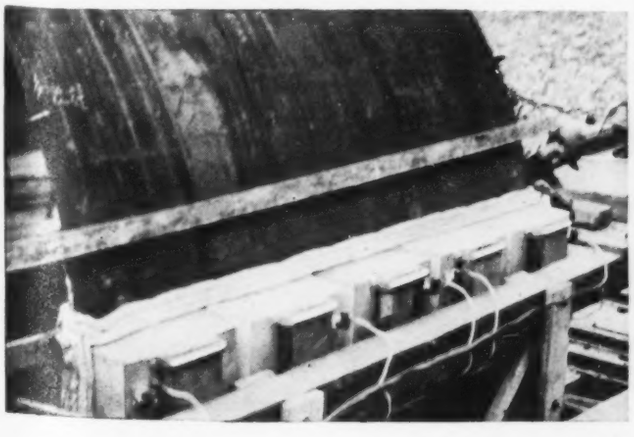
According to A.S.M.E. specifications, the procedure is to heat an area six times the thickness of the plate on each side of the joint seam. The heat is brought up to 1,100 to 1,200 deg. F. at the rate of one hour per inch of plate thickness, is held soaking at that temperature for one hour and then gradually cooled. The "Falcon" portable units that were designed for this job have heating faces 16 in. wide, which is sufficient for the 1¼-in. plate of the 30-ft. pipes and is, of course, more than enough when used on 1-in., or thinner, plate. A wound resistance heating element capable of operating at 1,900 deg. F. is contained in a refractory front piece and is so designed that the B.t.u. distribution compensates for the excess radiation losses at the cool edges and thus provides an even heat in the plate across the whole front of application. The element is backed by approximately 5 in. of block type insulation and the whole built into a sheet metal case. The heating surfaces of the units shown are 24 in. long and have each a capacity of 14 kw.

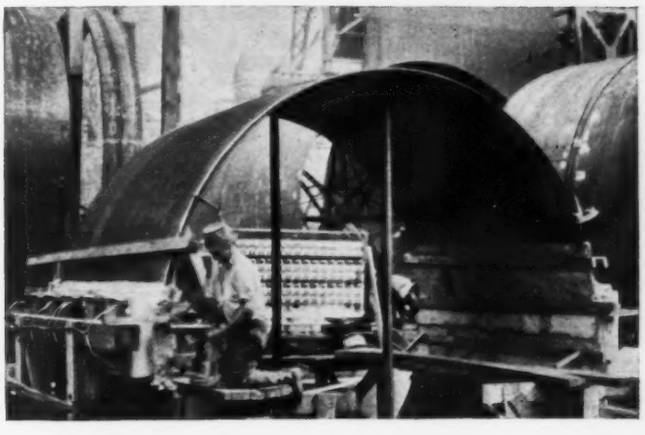
Operating figures for relieving stresses in a welded seam lengthwise of a 10-ft. pipe section of 1-in. plate, as shown, indicate that 5½ of the 24-in. units are required. The extra half unit is for overhang at the ends. Five units, as are shown in the illustrations, were used at first on the thinner plate and did the job satisfactorily, but it was found by experience that 5½ provided more uniform heating. The units have a total demand of 77 kw., which is on about 80 per cent of the time specified for bringing up to heat. During the soaking period the heaters operate about one-third of the time to make up for radiation losses. Thus about 87 kw.-hr. is consumed in treating the 10-ft. seam. The same units are used for circumferential as for longitudinal seams and may be applied either to the inside or outside surface of the pipe.



Electric heat takes stresses out of penstock seams

Heating units are clamped along and centering on seam on outside of pipe. Asbestos padding on the inside cuts down radiation losses. Thermocouples are peened into the surface of the pipe at different points along the seam for temperature control.





Converted Water Heaters Please Utility and Customers

By E. A. BRAND
Buffalo, Niagara & Eastern Power Corporation, Buffalo, N. Y.

In a territory where the gas-electricity competition is notably keen, this utility sought to promote electric hot water heating using clamp-on heaters.

Experimental developments, designed for off-peak service, have met the test of laboratory and field checks.

Economic and service factors encourage extension of the plan.

AN INVESTIGATION into the practicability of converting customers' existing galvanized range boilers to automatic electric water heaters was undertaken by the companies of the Niagara Hudson system for the following reasons:

1. Water heating gave promise of an attractive load in an appliance field not previously intensively developed by the companies involved.
2. The existing generation, transmission and distribution facilities were capable of serving additional load.
3. The border area near Niagara Falls and Buffalo was exposed to conversion water heating promotion activities of the Hydro-Electric Power Commission of Ontario.
4. In view of the fact that electric water heating had practically no acceptance among residence customers (except in one restricted area), and because of present economic conditions, it was felt that a reasonable saturation could not be secured quickly if promotion of the service were restricted to the rule of factory-built equipment by local dealers, even though the price of the service were made competitive. (The companies involved do not merchandise appliances.)

It was felt that the business should be taken on an off-peak basis if possible, so that the rate established would be low enough to make the service available to the majority of residence customers, would not limit the prospect list to range users and would permit rapid popularization of the new service.

In the territory of the up-state New York companies competition from other fuels is exceedingly keen, high B.t.u. content natural gas being available at 55 cents per 1,000 cu.ft. in certain areas and 900 B.t.u. mixed gas in Buffalo at 65 cents per 1,000 cu.ft. Hence, to secure a reasonable share of the business, it was essential that the water heating rate be established at as low a level as possible, to which off-peak service is the only logical solution for the companies involved. It was found that where heavy saturation of heaters had been secured by other utilities, these in practically every instance were developed by use of conversion equipments, a fact which influenced the company's choice to promote the use of such assemblies.

The practices of utilities both in the United States and in Canada which have had experience in water heating were thoroughly canvassed. The experience of associated companies in the gas water heating field was reviewed. Representative manufacturers of factory-built heaters were approached, but with the exception of one vendor, from whom wholehearted co-operation was secured, all advised against conversion equipment. The knowledge thus gained was utilized to the fullest extent, and the equipment assembly and practices as finally adopted represent ideas and materials from many sources.

A survey of plumbing supply houses indicated that approximately 75 to 80 per cent of range boilers sold were 30 gal. in size, the remainder being tanks of 40, 52, 66 and 82 gal. capacity. Hence it was felt that the conversion equipment must be suitable for the entire range, but that the tests should be confined chiefly to 30-gal. tanks.

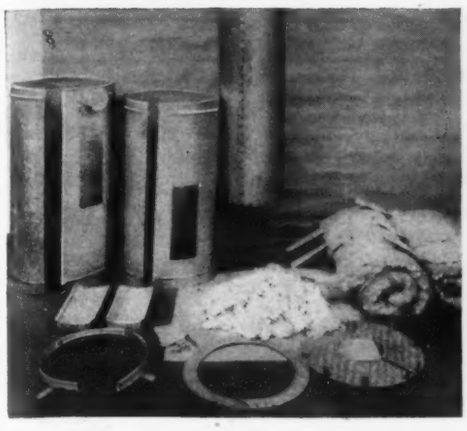
Strap-on heating element selected

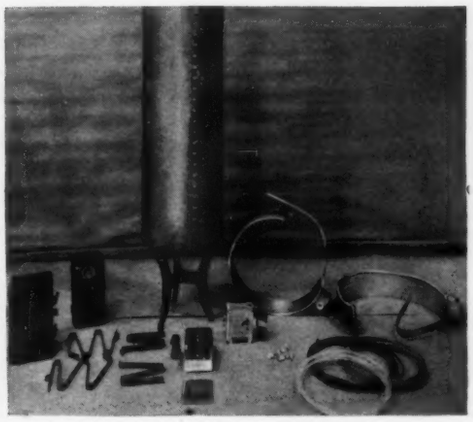
A decision to rely on strap-on heating elements was soon made, for the following reasons:

1. The responsibility for condition of the plumbing and tank could be avoided, if it became unnecessary to put a wrench to tank or plumbing. Experience of associated companies in the gas water heater field indicates that this is highly desirable to avoid customer complaints regarding possible plumbing leaks and failures at a later date.
2. Extensive use by other companies indicated that strap-on heating elements for the purpose in question were more trouble-free than were immersion elements.
3. A lower surface radiation in watts per square inch could be secured with strap-on units than with immersion. This is highly desirable to reduce scaling and heater burn-outs.
4. If the tank is well insulated, the efficiency of strap-on elements is only slightly less than that of immersion units.
5. The first cost of the strap-on element is 15 to 25 per cent below the first cost of the immersion element for the same wattage ratings.
6. Installation and maintenance cost of the strap-on element is less than that of the immersion element.

Circulation type heaters were not considered because of their first cost and the installation plumbing involved.

The heating element finally adopted is of Canadian origin, but built in this country by Hynes & Cox Com-



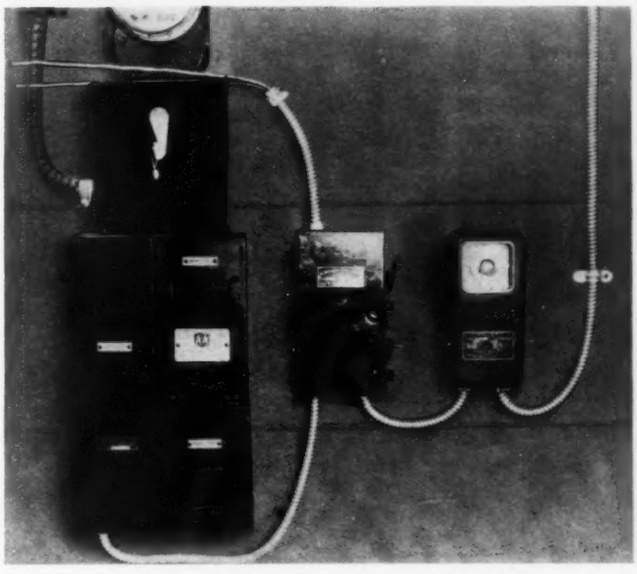


Equipment for converting existing boilers to electric water heating

Sheet-metal casing consists of two side-band sections with port covers, a supporting base band clamped around the tank, a flat base ring and a two-piece cover. Insulation is 2-in. rock wool blanket. Two heating elements and two thermostats are strapped on tank. Switch cabinet and time switch are on meter board.

Armored cable jumpers for connections to meter switch wiring

Meter board assembly for off-peak water heating.



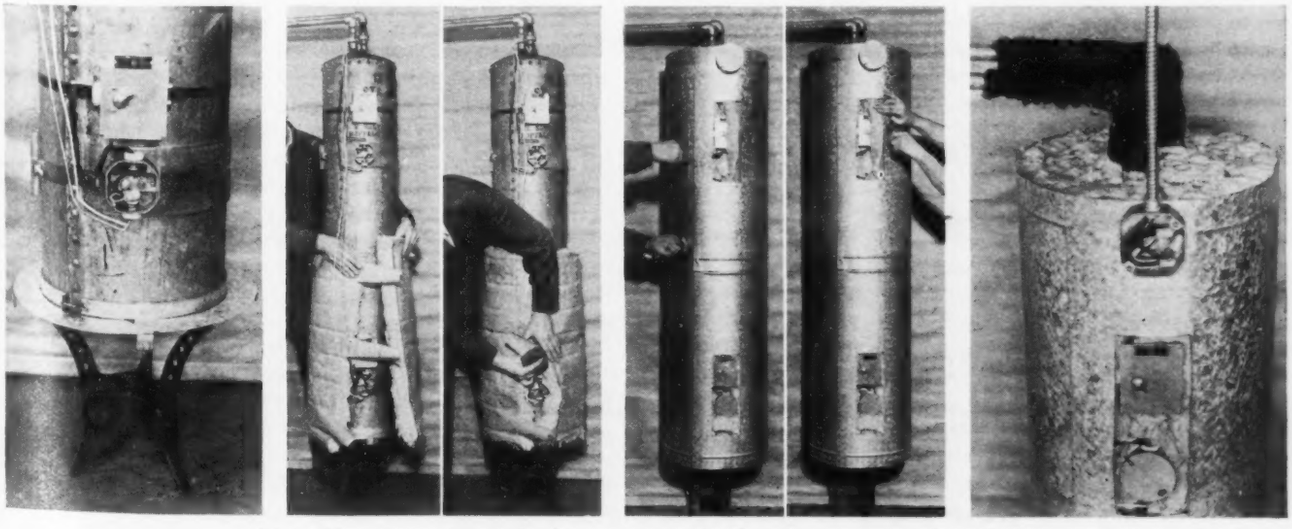
pany, Albany. It is flexible, the same style unit being used for any tank from 30 to 82 gal. in size.

The thermostat proved the most troublesome item of equipment. All American types submitted for test were found unsuitable, either because of price, because of the differential in degrees between "on" and "off" temperatures, or for other causes. Several popular units had a differential of approximately 40 deg. F., hence when adjusted to maintain 155 deg. F. tank water would not close to energize the circuit until the water temperature dropped to 115 deg. F. This will not create difficulty with normal water use in the home, but may cause dissatisfaction if the home-owner is absent for a day or a week-end, no water is being drawn and the heating element operates only to supply the idling losses.

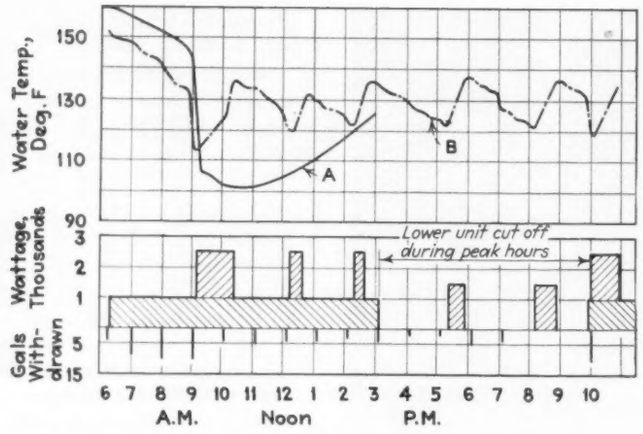
Strap-on thermostats were selected instead of immersion in order to avoid all plumbing responsibility. They are lower in first cost and will be easier to maintain and service than would immersion type units.

Tanks are well insulated

Thermal insulation was next considered. It was felt that the tank must be thoroughly insulated to prevent excessive losses and to increase the quality of service from the off-peak unit, since under the demand rate contemplated the customer's tendency would be to insist on the lowest possible wattage in order to reduce the monthly charge. Rock wool (not mineral wool) was selected as the best insulating medium, all points considered. Its most objectionable feature as used in the past is that it had to be packed into place by hand—a tedious process, time consuming and conducive to irregu-

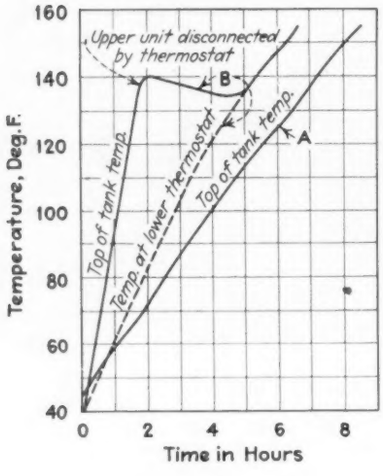


Successive stages in equipping range tanks for electric water heating



Ability of 30-gal. two-unit tank to maintain temperature on a day of heavy water draw-off

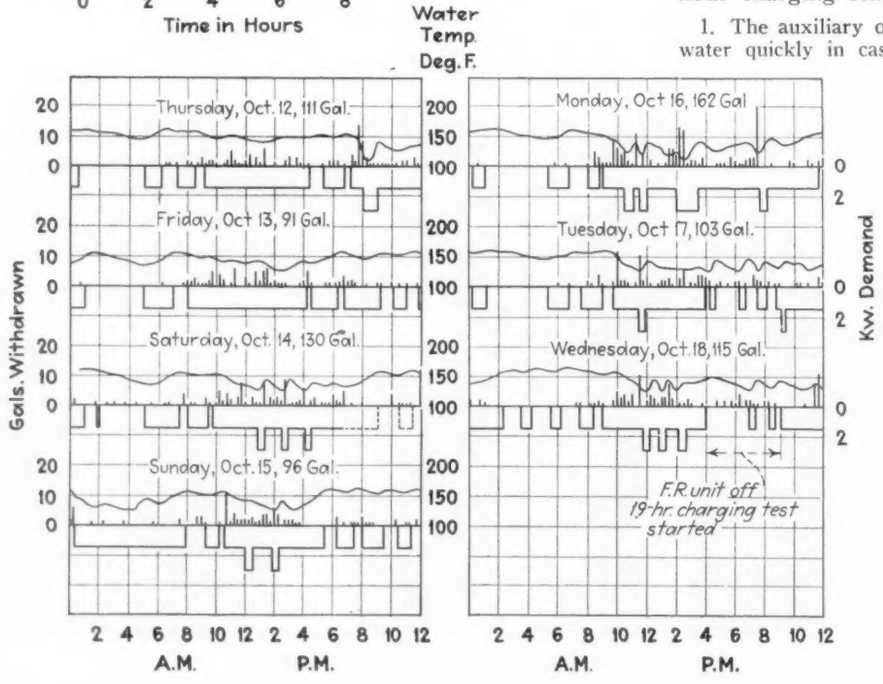
Only a few such days occur per month. 78 gal. draw-off.
Curve A—1,000-watt lower unit only, top of tank temperature.
Curve B—1,000-watt lower unit disconnected during peak hours, 3 to 10 p.m.; 1,500-watt upper unit floating on line.
Lower thermostat set at 155 deg. F., upper at 135 deg. F., inlet water 40 deg. F., 70 lb. pressure.
30-gal. range boiler with 2-in. rock wool insulation.



Advantage of two-unit tank in providing quick initial recovery for one-fourth tank capacity and quick recovery after tank is drained of hot water

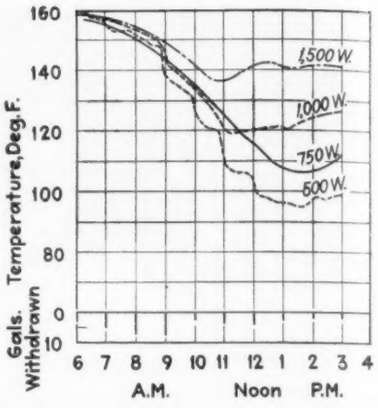
Wattage of upper element controls recovery time only.

30-gal. tank, 2-in. rock wool. Curve A, 1,000-watt lower unit only. Curve B, 1,000-watt lower unit, 1,500-watt upper unit.



Ability of single-unit 30-gal. tank to supply average day's hot water requirements

Need of an auxiliary top unit is indicated for low - wattage installations on 24-hour charging and for all installations on controlled charging hour service. 30-gal. range boiler, 2-in. rock wool, 57-gal. day, 41 gal of total of 57-gal. drawn between 6 a.m. and 3 p.m.



lar results in efficiency of the finished job. Hence several vendors were induced to stitch the rock wool in 2-in. thickness to a heavy kraft paper, to which gummed linen tabs are attached, thus providing a two-piece blanket that can be easily and quickly applied to the tank. Installation labor is reduced considerably and a 15 per cent reduction in standby losses is secured. Several pounds of loose wool are used to insulate the top of the tank.

While the equipment investigations were in progress laboratory tests were being conducted with several types of heating elements, thermostats and heat insulation. They consisted chiefly of:

1. Initial heating-up tests, single-unit vs. two-unit tanks.
2. Standby loss determinations on thermal insulation.
3. Water draw-off tests to determine ability to supply hot water requirements, both with 24-hour and with seventeen- or eighteen-hour daily charging periods.

A 30-gal. boiler was equipped with five thermocouples spaced equally from top to bottom to record water temperatures. Inlet water was held at 40 deg. F. and at 70 lb. gage pressure. The draw-off schedules were adapted from the standard N.E.L.A. 50- and 75-gal. set-ups and consisted actually of 57- and 78-gal. days.

It was soon found that two heating elements are highly desirable on tanks intended for 24-hour service and are absolutely essential on a 30-gal. tank with an eighteen-hour charging schedule:

1. The auxiliary or top unit is required to provide some hot water quickly in case the temperature of the entire tank has dropped below the usable point of 120 deg. F., due to heavy draw-offs, as on washdays. It provides for emergencies.
2. The top unit maintains temperature and supplies the occasional heavy demand when the off-peak unit is disconnected.

The auxiliary element is so located and controlled as to heat not more than 25 per cent of the tank capacity, carrying the temperature from approximately 120 to 135 deg. F. By adjusting its thermostat to 135 deg.,

Field test on conversion of 30-gal. tank

Family of 7 or 8. 1,500-watt lower and upper units, 24-hour charging period except 10/18. Water use 808 gal. Lower unit kilowatt-hours, 180; upper unit, 20. Curves show water consumption each fifteen minutes, top of tank temperature, hours of operation of each unit. On October 16 the customer tried out the installation to see what it would do.

whereas the off-peak unit is set for 155 deg. F. or higher, the duty on the auxiliary element, which is metered on the regular house service meter is kept low.

Auxiliaries and related items

Because of temperatures developed in the heater lead outlet boxes and in the thermostat cases, asbestos-insulated conductors were selected for wiring on the tank shell itself. Joints are made with porcelain solderless connectors, since composition-insulated connectors will not withstand the temperatures encountered. Soldered joints, of course, are out of the question.

The circuit between tank and meter board is carried in armored cable. A sealable cabinet containing two 30-amp. fused safety switches is installed on the meter board, the auxiliary element being wired through the top switch, the off-peak element through the lower one.

A time switch is used to control the charging hours of the off-peak element.

After the laboratory tests were well under way ten trial installations were made in employees' homes. The test sites were chosen to provide as wide a diversity as possible among habits of use and quantity of water drawn, also to determine if possible the limiting capacity of a 30-gal. tank to supply satisfactory hot water service. The number of persons per family varied from two to eight, with an actual hot water use per person per day ranging from 5 to 20 gal. and monthly use ranging from 500 to 4,800 gal. per family. The results obtained in general were satisfactory and sustained the laboratory test data.

The cost of the complete two-unit assembly with 1,000-watt or 1,500-watt heating elements completely installed on a 30-gal. tank, wired and connected ready to operate, but exclusive of the time switch cost, is approximately $39, including the wiring inspection fee. Equipment for a 52-gal. tank adds approximately $1.60 to the above cost.

Informal opinions on present conditions and problems confronting the industry are helpful. We welcome to this forum the type of discussion presented by Mr. Atkinson and hope others will discuss industry questions in a similar constructive vein.—EDITORS.

Kerr Atkinson says—

Jackson & Moreland,
Consulting Engineers, Boston, Mass.

Energy rates attain equilibrium when each customer gets his money's worth

To produce maximum revenues from the sale of any service it must be sold for what the traffic will bear, due regard being given to the effect of low rates as inducements to large consumptions and, hence, large revenues. Also, it is in the public interest that the shares of revenue derived from the several classes of customers be adjusted respectively in accordance with what their traffic will bear. Rates to any customer or class, of course, cannot profitably be reduced below the direct costs currently incurred by the delivery of service to it. But fixed operating costs and capital charges, once they are established, are but slightly affected by the number of customers attached and the amount of service taken. How are these charges to be allocated among the several classes of customers?

Many theories of allocation according to prorated costs have been devised. These have value as perspective in system planning and in satisfying public demand for rates having a so-called "fair" basis. In my opinion, however, they are academic as rate bases to a very large extent. For who can say whether "peak responsibility" rests with industrial or domestic users, or with any other class, when in many cases their demands may be of substantially equal magnitude but occur at different times? All demands are served from the same equipment.

Obviously, where responsibility for costs is indeterminate—as is always true to a large extent—the allocation which is fundamentally most economic, most in the public interest and most profitable to the power company is the one which will divide those costs to promote the fullest practicable use of the investment. This means selling for what the traffic will bear, or, to avoid an expression in some disrepute, selling service to the various classes of customers for what it is worth to them.

Under this system analyses of allocated utility costs become limits to the determination of rates that will develop load and meet competition rather than bases for rates. Analysis of consumer competitive costs and experiment with inducement rates determine the practical rate structure. The rates so established are fair in a real, rather than an academic, sense. For always beyond the effort of the power company to meet the competition of other sources of power is the competition of its customers among themselves each to get the most for his money and we attain equilibrium when each gets his money's worth.

In the domestic power field cost to the consumer of generating equivalent service is greatly in excess of its worth to him and, therefore, is no yardstick by which to set rates which will develop his load. In the industrial field, on the other hand, the consumer requiring a few hundred kilowatts or more can afford to generate himself unless he has a cheaper power source, and therefore in this field the cost to the consumer of generating his own power becomes the logical criterion for testing the soundness of public utility rates. As a matter of fact, for years, most utility commissions have been sufficiently realistic in their policies to recognize that rate fixing in the large power field is inherently a competitive affair.

There is nothing new in any of this. However, we are today subjected to the impact of so many theories seeking readjustments to idealistic and academic standards rather than realistic ones that it seems opportune to restate certain old principles which still underlie the fixing of all selling prices.

Simple Calculations Solve Practical Stability Problem

By R. H. DUVAL and L. T. EASTMAN

Engineering Department, Southern Sierras Power Company

Forced to make stability calculations in order to obtain stable system operation, engineers have long sought to orient theory and practice.

The authors here carry to conclusion and example the approach outlined in an earlier article.

FOLLOWING the development of a practical approach to the calculation of system stability for a four-machine utility (ELECTRICAL WORLD, April 7, page 514) one may analyze the actual solutions of the problem on the basis of a specific example.

The network of the system as simplified in the preceding article makes it readily possible to calculate internal voltages and the mechanical inputs of every machine and the angles between their internal voltages and the bus voltage at station "D," under normal operating conditions. Again station "A" will be used as an example. As was determined previously, the current $\times (\sqrt{3})$ supplied to the 110-kv. bus at station "D" by station "A" was 90.91 + j0 amp. In addition it must be considered that the current supplying an admittance of .50 + j.05 is brought over the equivalent circuit from station "A" to station "D" bus. This current $\times(\sqrt{3})$ equals $\frac{E \times Y}{1{,}000} = \frac{110{,}000\ (.50 + \text{j}.05)}{1{,}000} = 55.00 + \text{j}5.50$ amp. The total current then is 145.91 + j5.50 amp.

Voltage drop from station "D" 110-kv. bus to voltage "in back of" the generator transient reactance, or internal voltage, at station "A" equals $\frac{\frac{\sqrt{3}I}{y}}{10^3}$

$$= \frac{(145.91 + \text{j}5.50) \times 10^3}{.33 - \text{j}3.77} = 1930 + \text{j}38{,}542 \text{ volts.}$$

Then the internal voltage is 110,000 + 1,930 + j38,542 = 111,930 + j38,542 = $(111{,}930^2 + 38{,}542^2)^{\frac{1}{2}}$ = 118,380 volts. The mechanical input equals the electrical output (assuming no losses) under normal operating conditions, so mechanical input equals power taken by equivalent circuit from station "A" to station "D" bus plus the power taken by the admittance on the internal voltage of station "A" generator, or mechanical input equals (111.930 — j38.542) × (145.91 + j5.50) + (111.930 — j38.542 × (111,930 + j38,542) × $\frac{(.26 - \text{j}.21)}{1000}$ = 20,187 kw. (real component only).

From the power-angle equations for two machines,

$$P_s = (y_s + y_{rs})\ {}_1E_s^2 + Y_{rs} E_r E_s \sin(\theta_{rs} - \delta_{rs}) \qquad (8)$$

Where the notation is the same as given for the general power equations in the appendix and the subscripts "s" and "r" denote sending and receiving ends, or station "A" and station "D" 110-kv. bus respectively. Substituting, in (8),

$$20{,}187 = (.26 + \text{j}.33) \times 118.379^2 + (.33^2 - 3.77^2)\tfrac{1}{2} \times 110.000 \times 118.379 \times \sin\left(\theta_{rs} - \tan^{-1}\frac{.33}{3.77}\right)$$

$$= 8268 + 49223 \times \sin(\theta_{rs} - 5.00°)$$

$$\text{or, } \sin(\theta_{rs} - 5.00°) = .2421$$

$$(\theta_{rs} - 5.00°) = 14.01°$$

$$\theta_{rs} = 9.01°$$

The internal voltages, mechanical inputs and the angles which the internal voltages of stations "B," "C" and "D" machines make with the station "D" bus, under normal conditions, are obtained in the same manner and the results tabulated in Table I.

Fault calculations

The fault to be considered is a single-phase-to-ground fault on the 220-kv. line C-D near station "C." A fault may be considered as merely an additional load on the system at the point of fault. This load is determined by placing the zero-phase-sequence admittance and the negative-phase-sequence admittance of the system to the point of fault in series to ground. It should be noted that the zero-phase-sequence admittance involves only the line C-D as the transformer connections at each end of the line are such (star-delta with the grounded star

Table I—Internal Voltages, Mechanical Inputs and Machine Rotor Angles

With System in Normal Operating Condition Before Fault

	Station "A"	Station "B"	Station "C"	Station "D"
Internal voltage, kv.	118.379	113.128	102.514	121.355
Mechanical input, kw.	20,187	29,156	20,676	15,109
Angle between internal voltage and Station "D" 110-kv. bus.	+9.01°	+8.18°	+7.06°	+6.01°

on the line side) that zero-phase-sequence current cannot flow through them. The negative-phase-sequence admittance network is the same as the positive-phase-sequence network (Fig. 2) except that the negative-phase-sequence admittances of the generators replace the transient admittances. For the method of setting up the zero- and negative-phase-sequence admittance networks of the system the reader is referred to N.E.L.A. Relay Handbook Supplement (1931). It should be remembered that in this problem the current (or power) at the point of fault is to be determined and not that on the various machines and lines as in the handbook. For this system the negative-phase-sequence admittance is $4.35 - j16.55$ mhos ($\times 10^3$) and the zero-phase-sequence admittance is $10.90 - j60.76$ mhos ($\times 10^3$) to the point of fault. Placed in series, these values give an admittance of $3.18 - j13.02$, which is applied at the point of fault as a three-phase load.

The next step is to set up the system network, including the fault load, and the corresponding power-angle equations. This network is the same as that given in Figs. 2 and 3c except for that portion of the network on the station "C" side of the station "D" bus. This portion of the network must be recalculated to include the fault load. The auxiliary constants of the 220-kv. line C-D as given above in "System Data" are transformed into equivalent pi-circuit admittances and these admittances then multiplied by $220^2/110^2$, or 4, to place on a 110-kv. voltage base, giving $y_r = y_s = 0.76 - j.56$ and $y_L = 17.52 - j36.16$. The portion of the network to be recalculated is shown in Fig. 4a with the different admittances indicated. By two star to delta conversions Fig. 4a is transformed into Fig. 4b, which is in a form to combine with Fig. 3c (exclusive of the portion of the network on the station "C" side of the station "D" bus). In Fig. 5 this combination is shown with all admittances on the station "D" bus paralleled. To set up the power-angle equations it is necessary to convert this five-cornered star to a five-cornered mesh (ground or neutral being the fifth corner). Fig. 6 indicates the results of this conversion and is in a form to have applied to it the power-angle equations.

Power-angle equations during fault

The angles between the rotors of the machines of the system under normal conditions of operation are

$$\theta_{ab} = 9.01° - 8.18° = 0.83°$$
$$\theta_{ac} = 9.01° - 7.06° = 1.95°$$
$$\theta_{ad} = 9.01° - 6.01° = 3.00°$$
$$\theta_{bc} = 8.18° - 7.06° = 1.12°$$
$$\theta_{bd} = 8.18° - 6.01° = 2.17°$$
$$\theta_{cd} = 7.06° - 6.01° = 1.05°$$

and will be all positive values if station "A" is ahead of "B" and "B" ahead of "C," etc.

The admittances ($\times 10^3$ are)

$y_{ab} = -.16 + j\ .86$
$y_{ac} = -.08 + j\ .48$
$y_{ad} = -.16 + j\ .77$
$y_{bc} = -.20 + j\ .93$
$y_{bd} = -.36 + j1.49$
$y_{cd} = -.19 + j\ .83$
$y_{aa1} = 0.66$
$y_{bb1} = 1.22$
$y_{cc1} = 0.56$
$y_{dd1} = 0.57$

The internal voltages from Table I (constant throughout)

$E_a = 118.379$ kv.
$E_b = 113.128$
$E_c = 102.514$
$E_d = 121.355$

$E_a^2 = 14{,}014$ (kv.^{2})
$E_b^2 = 12{,}798$
$E_c^2 = 10{,}509$
$E_d^2 = 14{,}727$

The polar form of conjugate line admittances ($\times 10^3$) are

$y_{ab} = .87 \angle 100.54°$ or $Y_{ab} = .87$
$y_{ac} = .49 \angle 99.47°$ $Y_{ac} = .49$
$y_{ad} = .78 \angle 101.74°$ $Y_{ad} = .78$
$y_{bc} = .95 \angle 102.13°$ $Y_{bc} = .95$
$y_{bd} = 1.53 \angle 103.58°$ $Y_{bd} = 1.53$
$y_{cd} = .85 \angle 102.90°$ $Y_{cd} = .85$

and the complements of the admittance angles are

$\delta_{ab} = -10.54°$
$\delta_{ac} = -\ 9.47°$
$\delta_{ad} = -11.74°$
$\delta_{bc} = -12.13°$
$\delta_{bd} = -13.58°$
$\delta_{cd} = -12.90°$

$E_a \times E_b = 13{,}392$ (kv.^{2})
$E_a \times E_c = 12{,}136$
$E_a \times E_d = 14{,}366$
$E_b \times E_c = 11{,}597$
$E_b \times E_d = 13{,}279$
$E_c \times E_d = 12{,}440$

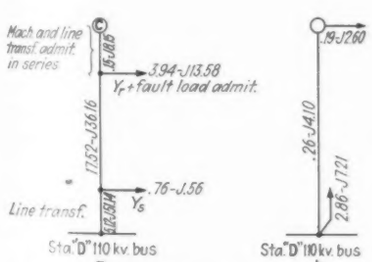


Fig. 4—Portion of system with fault

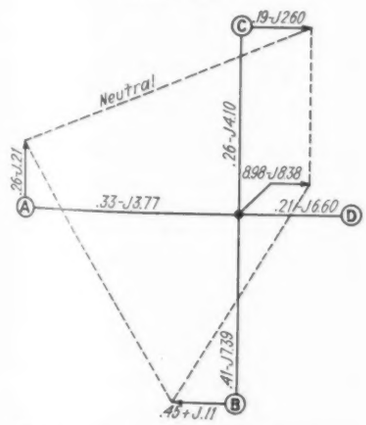


Fig. 5—System during fault

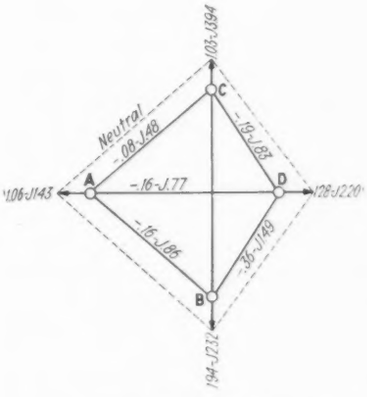


Fig. 6—Simplified system during fault

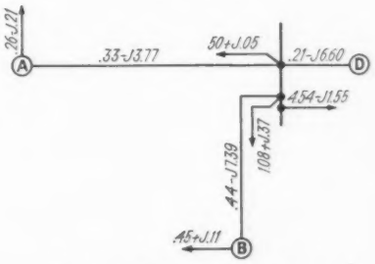


Fig. 7—System after fault

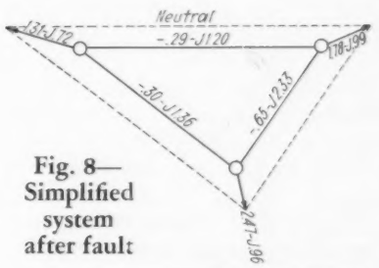


Fig. 8—Simplified system after fault

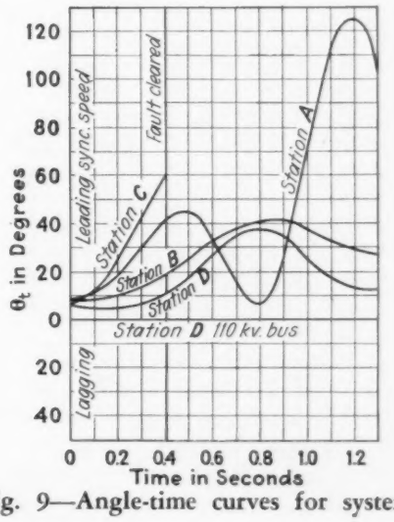


Fig. 9—Angle-time curves for system

These values are now substituted in the power-angle equations (giving power in kw.).

$$P_a = 9{,}240 + 11{,}651 \sin(\theta_{ab} + 10.54) + 5{,}947 \sin(\theta_{ac} + 9.47) + 11{,}205 \sin(\theta_{ad} + 11.74)$$
$$P_b = 15{,}600 - 11{,}651 \sin(\theta_{ab} - 10.54) + 11{,}017 \sin(\theta_{bc} + 12.13) + 21{,}005 \sin(\theta_{bd} + 13.58)$$
$$P_c = 5{,}890 - 5{,}947 \sin(\theta_{ac} - 9.47) - 11{,}017 \sin(\theta_{bc} - 12.13) + 10{,}574 \sin(\theta_{cd} + 12.90)$$
$$P_d = 8{,}700 - 11{,}205 \sin(\theta_{ad} - 11.74) - 21{,}005 \sin(\theta_{bd} - 13.58) - 10{,}574 \sin(\theta_{cd} - 12.90)$$

and substituting the values of θ_{ab}, θ_{ac}, etc.,

$P_a = 15{,}570$ kw.
$P_b = 25{,}790$
$P_c = 11{,}320$
$P_d = 16{,}430$

These power quantities are the electrical outputs of the different generators at the instant after the fault is applied. The available accelerating power, or ΔP, at this instant, or at the beginning of the first interval, for each machine, is found by subtracting from the mechanical input (constant) the electrical output.

$\Delta P_a = 20{,}190 - 15{,}570 = +4{,}620$ kw.
$\Delta P_b = 29{,}160 - 25{,}790 = +3{,}370$
$\Delta P_c = 20{,}680 - 11{,}320 = +9{,}360$
$\Delta P_d = 15{,}110 - 16{,}430 = -1{,}320$

Step-by-step method

Now to obtain the actual acceleration in electrical degrees per second per second for each machine it is necessary to arrive at a relation between ΔP and degrees acceleration involving the inertia of the machine. If α is the acceleration in electrical degrees per sec.^{2}, f is the frequency of the system in cycles per second (assumed constant during the investigation), ΔP is the mechanical input minus the electrical output (in kw.), and K is the stored energy of the machine rotor, including that of the prime mover in kw.-sec., at synchronous speed, which equals 2.3 $(WR^2) \times n^2 \times 10^{-7}$, where WR^2 is the inertia in lb.-ft.^{2} of generator and prime mover rotors, and n is the r.p.m., then

$$\alpha = 180 \times f \times \frac{\Delta P}{K} \qquad (9)$$

The factor $\frac{180 \times f}{K}$ is a constant for each machine, K_1

Station "A" generator $K_1 = .120$
Station "B" generator $K_1 = .027$
Station "C" generator $K_1 = .096$
Station "D" generator $K_1 = .045$

By inserting the values of ΔP in equation (9) the acceleration for the first interval can be obtained for each machine. The angular position of the rotors θ_t of the various machines with respect to the station "D" bus (or synchronous speed) at the end of the first interval can be obtained from the following common formula of physics

$$\theta_s = \omega t + \frac{\alpha t^2}{2} \qquad (10)$$

Where θ_s is change in electrical degrees in position of rotor from that at synchronous speed.
ω is angular velocity in electrical degrees at beginning of interval.
t is length of interval in seconds and in this problem is 0.
α is angular acceleration in electrical degrees per sec^2.

Then θ_t equals the initial angular position of the machine with respect to the station "D" bus plus θ_s. After obtaining the angular position θ_t of each machine, the angles θ_{ab}, θ_{ac}, etc., can be calculated, substituted in the power-angle equations above, new ΔP's obtained, and the change in angular positions, θ_s, for the succeeding 0.1 second interval worked out, and so on through the whole time of investigation.

Power-angle equations after fault

In this problem the fault is assumed to be cleared in 0.4 second, or at the end of the fourth interval. When the fault is cleared the system network again changes and consists of only the three stations "A," "B" and "D" and their connecting lines and loads as shown in Fig. 7. This four-point star is simplified, as before, into a four-cornered mesh and the simplified network is given in Fig. 8. The treatment is now the same as when the fault first occurred. Power-angle equations are derived from the new system network of Fig. 8. The angles θ_{ab}, θ_{ad} and θ_{bd} at the end of the fourth interval are inserted in the power-angle equations and P obtained for each of the three machines at stations "A," "B" and "D" and the calculations for the following intervals carried out

Table II—Calculations for a Single Station

Station "A"

Line	0.1 second intervals	1	2	3	4	5	6	7	8	9	10
1	ΔP	4,620	3,520	1,590	—800	—13,120	—10,930	220	15,620	33,020	8,890
2	$K_1 = 180 \times f \div K$	0.120	.....	.....	.....	.....	.....	.....	.....	.....	.....
3	θ_t at beginning of interval	9.01°	11.78°	19.44°	30.19°	41.42°	44.30°	32.74°	14.75°	6.26°	26.95°
4	$\omega = K_1 \Delta Pt = .0120\ \Delta P$ (in degs./sec.)	55.5 °	42.5 °	19.1 °	— 9.6 °	—157.5°	—131.2 °	2.6 °	187.5 °	396.0 °	106.8 °
5	ωt	0	5.55°	9.80°	11.71°	10.75°	— 5.00°	—18.12°	—17.86	0.89°	40.49°
6	$\alpha t^2 \div 2 = .000600\ \Delta P$	2.77°	2.11°	0.95°	— 0.48°	— 7.87°	— 6.56°	0.13°	9.37°	19.80°	5.34°
7	θt at end of interval	11.78°	19.44°	30.19°	41.42°	44.30°	32.74°	14.75°	6.26°	26.95°	72.78°
8	θ_{ab}	3.15°	9.31°	17.03°	22.84°	18.89°	0.69°	—23.01°	—34.86°	—14.02°	35.38°
9	θ_{ac}	0.23°	— 4.73°	—11.63°	.....	.....	.....	.....	.....	.....	.....
10	θ_{ad}	6.07°	14.23°	24.23°	31.09°	26.28°	5.07°	—20.23°	—32.36°	— 7.83°	47.72°
11	δ_{ab}	—10.54°	.....	.....	—12.35°	.....	.....	.....	.....	.....	.....
12	δ_{ac}	— 9.47°	.....	.....	.....	.....	.....	.....	.....	.....	.....
13	δ_{ad}	—11.74°	.....	.....	—13.59	.....	.....	.....	.....	.....	.....
14	$\sin(\theta_{ab} - \delta_{ab})$	.2536	.3395	.4629	.5763	.5188	.2257	—.1850	—.3829	—.0291	.7400
15	$\sin(\theta_{ac} - \delta_{ac})$	.1685	.0826	—.0376	.....	.....	.....	.....	.....	.....	.....
16	$\sin(\theta_{ad} - \delta_{ad})$	.3059	.4380	.5876	.7031	.6410	.3200	—.1156	— .3201	.1003	.8772
17	$Y_{aa} E_a^2$	9,240	.....	.....	10,080	.....	.....	.....	.....	.....	.....
18	$Y_{ab} E_a E_b$	11,650	.....	.....	18,750	.....	.....	.....	.....	.....	.....
19	$Y_{ac} E_a E_c$	5,950	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	$Y_{ad} E_a E_d$	11,210	.....	.....	17,670	.....	.....	.....	.....	.....	.....
21	$+ Y_{ab} E_a E_b \sin(\theta_{ab} - \delta_{ab})$	2,960	3,950	5,390	10,800	9,720	4,240	—3,470	—7,180	—550	13,870
22	$+ Y_{ac} E_a E_c \sin(\theta_{ac} - \delta_{ac})$	1,030	490	—220	.....	.....	.....	.....	.....	.....	.....
23	$+ Y_{ad} E_a E_d \sin(\theta_{ad} - \delta_{ad})$	3,440	4,920	6,580	12,430	11,320	5,650	—2,040	—5,650	1,770	15,600
24	Total power output	16,670	18,600	20,990	33,310	31,120	19,970	4,570	—12,830	11,300	39,550
25	Mechanical input	20,190	.....	.....	.....	.....	.....	.....	.....	.....	.....

as before. These calculations should not be carried much beyond one second as the various automatic devices regulating voltage and mechanical inputs will begin to be effective.

A tabulation of the calculations (Table II) for station "A" for 0 to 1.0 second only) is given and examination of this will make the steps more clear. In working out the problem, of course, tabulations in this form must be carried along simultaneously for all stations. It should be noted in Table II that lines 1 to 7 inclusive are the calculations for the changes during the interval in question and lines 8 to 25 inclusive are the calculations concerning the increment P to be used in the next interval. Line 4 is the angular velocity at the end of the interval and multiplied by 0.1 gives the value of the first member in the left-hand side of equation (10), the ωt to be used in the next interval (line 5). Line 7 is the sum of lines 3, 5 and 6. Lines 8, 9, and 10 are derived from the lines 7 of the tabulations for all the machines. Line 24 is the sum of lines 21, 22 and 23. Line 1 is derived from lines 24 and 25 of the previous interval. It is noteworthy that all values in this table require only slide-rule accuracy.

Angle-time curves

The results of the calculations are plotted in Fig. 9. It can be seen that station "C" speeds up rapidly, tending to leave the other machines, and shows no inclination to follow the other machines up to the time the fault (and the machine also in this case) was cleared at the end of 0.4 second. If the fault had not been cleared instability would have probably resulted. All of the other stations tend to speed up due to necessary changes in phase angles required by the new system load distribution and also due to loss of load because of lowered bus voltages. After the fault is cleared, these machines continue to increase their displacements for a short interval of time because of their inertias. At about the eighth interval the system begins to slow down as the system recovers, as stations "A," "B" and "D" must take up the load that has been dropped by station "O." The system will continue to slow down until the automatic regulating devices come into play. From the curves it is seen that station "A" oscillates, because of its relative lightness, around stations "B" and "D," but shows no tendency to go beyond the point where no effective restoring force is present. Actually the oscillations are very much exaggerated due to taking a constant accelerating force over a 0.1 second interval. As the error due to this method is cumulative the swings become of greater and greater amplitude with time. It would probably be found by using the corrective method outlined below that station "A" would swing a few degrees on either side of stations "B" and "D" with swings of decreasing amplitude with time until it found a steady state position. The rate of slowing down of stations "B" and "D" seems to decrease at about 1.0 second, but this is due to the great amplitude of the swing of station "A" at this point and again is due to the error of using the 0.1 second interval. This error due to the interval must always be taken into account when analyzing the curves.

Correction of step-by-step method

In the first part of this article the fact that the accelerating power was not constant throughout the interval, but was constantly changing, was discussed. The step-by-step method used in this problem may be corrected to take this fact into account, if it is necessary, by the means outlined below.

At the beginning of the interval the electrical outputs of the machines and the angles θ_{ab}, θ_{ac}, etc., are known. From these the following may be calculated:

1. ΔP, the power available for acceleration.
2. The acceleration during the interval.
3. The change in angle due to this acceleration.
4. The change in angle due to the speed (ω) at the beginning of the interval.
5. From 3 and 4 the total change in angle during the interval.

as in lines 1 to 7 of Table II for each machine. Then calculate:

6. From 5 and the known angles the machines make with the station "D" bus, θ_i, at the beginning of the interval, the angles θ_{ab}, θ_{ac}, etc., at the beginning of the next interval as in lines 8 to 10 of Table II.
7. From the power-angle equations and 6 the approximate power outputs of the machines at the beginning of the next interval as in lines 14 to 24 of Table II.
8. From 7 the difference in power output at the beginning of the interval and the beginning of the next interval.
9. From 8 the acceleration (α') due to this difference.
10. From 9 the secondary change in angle (θ_a') due to α', where θ_a' equals $\frac{\alpha' t^2}{6}$, and the corresponding changes θ_{ab}', θ_{ac}', etc.
11. The corrected angles θ_{ab}, θ_{ac}, etc., from the sum of 6 and 10, which are the angles to use at the beginning of the next interval.
12. From 3 the change in speed during the interval (ωt) as in line 4 of Table II.
13. From 9 the secondary change in speed due to α', where $\omega' = \frac{\alpha' t}{2}$
14. From the speed at the beginning of the interval and 12 and 13 (summation of all three) the speed ω to use at the beginning of the next interval. (It should be noted in all cases at synchronous speed that $\omega = 0$.)

Germany's 380-Kv. Line

Running north and south in western Germany is a double circuit often referred to as the highest voltage transmission line in the world. It belongs to the Rhine-Westphalia Power Corporation (R.W.E.), is about 600 miles in length and extends from Bludenz in Austria, close to the Swiss border, to Brauweiler, in the great iron and steel district near Holland and Belgium.

In 1922, when the R.W.E. began the construction of its first 220,000-volt line, according to a descriptive booklet issued by the company, two 220,000-volt lines were already in existence in California, but as the neutral was grounded the phase voltage to earth was only 127,000 volts. In Germany, where grounding could not be used because of objections by the post office and railway authorities, it was necessary to use full 220,000-volt insulation.

To meet possible future requirements the R.W.E. so designed its main line that the tension on it might be increased to 380,000 volts, as soon as the authorities had become convinced that grounding the neutral would be permissible.

To avoid excessive corona losses at the latter voltage a conductor diameter of 1.65 in. was required. Economy of copper dictated the use of hollow cables. One design uses interlocking strips, spirally arranged. Another uses two layers, the inner one being of I-beam construction.

This Plan Reduced Energy Diversion

By W. W. PALMER*

Only 6 per cent of this utility's customers are judged dishonest, but a definite persuasive plan to handle those few pays well.

Each dollar spent for special investigation brings in three dollars of revenue otherwise lost.

KNOWING that an unsealed meter is defenseless and an unsealed safety switch and fuse box is more effective in concealing tampering than an open switch we began housecleaning by thoroughly modernizing our sealing methods and seals. Sealing irons were issued with a clear understanding that each user would be held personally responsible for their proper use and would have $5 deducted from his pay check in case of loss or if an unauthorized person were allowed to use them. After all sealable revenue metering equipment was properly secured meter readers and service men were required to report in writing each seal found broken or tampered with. Customers who frequently tampered with seals were generally found to have sinister motives. No meter cover was resealed without testing the meter.

In planning our campaign against current theft we assumed that 10 per cent of the residential, commercial and small industrial consumers were guilty, while 90 per cent were out of the picture. Only about 5 per cent of the total were already equipped with theft-proof metering equipment. Assuming $10 as the average unit cost of this equipment, we faced a maximum outlay of $950 per 100 customers and a minimum of $50. The amount we would spend above the minimum would indicate our inability to locate the guilty. Revamping all old equipments was not considered on account of the excessive cost. Inspecting all customers to locate the ten was not considered seriously, because the good will of those 90 was too valuable to risk losing, the time required would be too great, the inspections too expensive and the class of people we were after moved more frequently than any other. We chose a simpler attack.

Special investigation service organized

Roughly dividing our system into geographic units of 10,000 meters each, we employed a special investigator for each unit and a chief investigator to co-ordinate their efforts. These investigators were instructed to clean up their respective districts with the least cost and in the shortest time possible. After a series of investigators' meetings each went to his respective district and held ten one-hour meetings with all meter and service men. These employees were thoroughly instructed on how to recognize evidence of theft and were given forms (Fig. 1) on which to report suspected customers. They were specifically ordered not to inspect suspicious premises or to attempt to prove their suspicions. A reward of $2 was offered for each reported case which was subsequently proved by the investigator, who was not eligible for rewards himself. Naturally, all reports are kept strictly confidential.

At an opportune time each inspection is made with the following objectives:

1. To find defrauding equipment in place if possible.
2. To determine if the customer uses such equipment, although it may not be in place at the time of inspection.
3. To decide if the case might be caught by a night inspection or must be stopped at company expense.

[redacted] Case No. 50250

REPORT OF UNAUTHORIZED USE OF ELECTRICITY

Use Reverse Side for Sketch if it Will Clarify Description

Customer John Doe Date 3-26-34
Address 321 Maple Avenue City
Kind of Premises Residence
Location of Meter Back Porch
Suspected Method of Securing Service Without Proper Meter Registration

Mrs. Doe bragged that she always paid a minimum bill

The Following Parties Are Suggested as Having Information Bearing on the Above:
Name H. A. Jones Address 323 Maple Avenue

Signed W. M. Brown Title Meter Reader Location Cherokee

This form should be filled out as completely as possible and given to your Foreman or immediate Superior who will send it to the District Manager, who will immediately send copy to Division Meter Supervisor. Do not make report unless you have some definite or tangible evidence or reason for thinking that electric energy is being used without being properly registered on the meter.

FIG. 1

Fig. 1—Investigator reports suspected cases on this form

[redacted] Case No. 50250

INVESTIGATOR'S REPORT

Date 3-28-34
Customer John Doe Address 321 Maple Ave City
Business Jamison Bowling Co Kind of Premises Residence

METER DATA

Meter No. 986231 Amps. 10 Volts 110 Wire 2 Phase 1 Constant 1 Terminals 4
Is Pot. Coil connected ahead of Fuse No Is Meter connected ahead of Switch and Fuse No Is Potential Connection made by Tap No Reading 0326

LOAD DATA

H.P. Motors None Range No Water Heater No Refrigerator Yes
Owner of Premises Jackson Realty Co
Nature of Irregularities One circuit tapped to service ahead of meter. Refrigerator, radio and 2-75 watt lamps unregistered.
Is Service Hot? Yes Is Meter Damaged? No
Type of Service Entrance (Conduit, Open Wire, etc.) Open wire - concealed
Type of Switch (Accessible Fuse, Sealed Fuse, Open, etc.) Open
Does Service Entrance and Equipment Conform to [redacted] Power Co. Specifications No
Who Was Interviewed? Mr J N Smith Business Maid
What did they say? Mr Doe's son, now at college, fixed the wrong about eight months ago.
What did you say? Requested that Mr Doe come to our office for interview.

Time of Investigation 9:00 A.M Date 3-28-34
Witnesses: Mr J N Smith, H A Jones
Address: 496 Eastwood St., 323 Maple Ave
Exhibits Secured: None
Photographs Taken: One
Recommendations and Remarks: That Mr Doe be required to pay $5.00 back bill and install modern outdoor metering equipment.
Investigated By:
FINAL DISPOSITION: Mr Doe paid $4.00 cash and had his contractor install outdoor equipment. Act on 3-30-34
J N Ouist
Use additional sheet for sketches or additional information. District Manager

Fig. 2—Full record of case is made this way

*Mr. Palmer is special investigator for a large utility.

4. To get as much data on customer as possible, such as other meters he may be interested in, relatives, etc.

All investigations are kept on a friendly plane and the customers are encouraged to talk freely. Apparently the purpose of inspection is to forestall service calls, but no source of evidence is overlooked. The attic is checked where advisable. All data are recorded on a "Routine Inspection" form (Fig. 2) in the customer's presence. At the office these reports are divided into three classes. Cases dropped are filed, those to be reinspected are returned to the investigator, while those caught are turned over to the auditor, who gets the customer to his office and asks him to install modern metering equipment and pay an estimated back bill. Except in unusual cases service is discontinued if the customer refuses. If he moves the investigator relocates him.

Through this clue system 14 per cent of our customers have been reported as suspicious and 25 per cent of the cases reported have been proved. We believe our original estimate of 10 per cent dishonest customers was at least 4 per cent high. Of those proved, 5 per cent were caught on first inspection, 10 per cent on reinspection and the balance were cured at company expense. We feel sure that if a defrauder cannot be caught in two or three inspections it is much better to stop the leak immediately, thereby saving further revenue loss and inspection expense. A special meter sheet for each meter "beater" is kept by the investigator to show his increase in consumption after detection.

We find that for each dollar spent on this work we are securing three dollars in increased annual return. We believe that is no mean return.

Adequate Maintenance Pays

Georgia Power, adopting a standardized schedule and well-manned organization, finds proper maintenance to return many tangible benefits.

How substations and transmission lines as well as tests of insulation and oil are taken care of.

THE maintenance organization of the Georgia Power Company is developed for each of six operating divisions and consists, for each division, of one substation crew of six men, one to four transmission crews with five or six men per crew, six distribution crews, each consisting of five or six men, one floating crew and two or three special crews for tree trimming and other duties.

Standard instructions to the crews for the maintenance of substations are as follows:

(a) *Testing Insulating Oil*—Transmission substation equipment every three months, customer and central substation equipment every six months. Exceptions, every twelve months, and these consist of 13-kv. transformers or less rated 100 kva. or less, low-tension bank breakers at 11 kv. or below in customer or central substations and induction regulators.

(b) *Meggering Power Transformers*—Transmission substations every six months, customer and central substations every twelve months.

(c) *Overhauling Oil Circuit Breakers*—In addition to routine testing each breaker is given a complete overhaul; the frequency, during any twelve-month period, is left to the discretion of the division superintendent. Every breaker is to be given a complete overhaul at least once a year. Each phase of every breaker is to be meggered as an integral part of the periodic overhaul.

(d) *Rotating Substation Equipment*—A complete overhaul at least once a year for all synchronous condensers, rotary converters and motor-generator sets. This overhaul includes detail measurement of insulation and all lubricating oil must be changed once each year.

(e) *Induction Regulators*—A systematic over-all inspection every six months.

(f) *Fuses*—Fuses installed in transmission, customer and central substations of the type whose fusible elements are inexpensive and renewable links are subject to this maintenance. Fuse links are to be removed and replaced at least once a year.

(g) *Substation Grounds*—Where practical, ground resistance values shall be kept to the following values: Transmission substation, less than 5 ohms; customer and central substations, less than 15 ohms. Ground resistances are to be measured at least once a year, and if in excess of these values an attempt must be made to lower them.

The standard instructions for the maintenance of transmission lines are as follows:

(a) *Testing Insulators*—After a study of insulator test records of the previous year the general office sends each division a list of lines on which insulators are to be tested during the following season. This list is sent in November and December and the tests and replacements are to be complete by the end of the following March.

(b) *Patrolling*—Lines from 110 kv. to 19 kv. inclusive should be patrolled according to the following schedule in so far as this is practicable.

	October to March	April to September
Average lines	4 weeks	2 weeks
Important lines	2 weeks	2 weeks
Unimportant lines	4 weeks	4 wekes

Regardless of the above classification every line of the transmission system is to be given a complete patrol at least once a month.

(c) *Clearing Rights-of-way*—110 kv. to 19 kv., once every five years. In general, operations should be during the period August to November. A patrol path must be kept clear on all lines.

(d) *Inspection of Line Structures and Equipment*—110 kv. to 19 kv., inclusive, lines are given a detailed structural inspection at least once every three years. These inspections cover burned conductors or ground wires, loose suspension or ground wire clamps, loose and missing bolts and nuts, defective insulators, loose or defective tie wires, etc.

(e) *Poles*—To prolong the life of poles on 110-kv. to 19-kv. lines the following practices are adopted:

Superfluous drilled holes in new poles are to be filled

with creosoted plugs, tops of all new poles are to be covered with sheet copper; unless absolutely necessary the tops of poles shall not be cut off, nor shall additional gains be cut in the poles. If this work is necessary, however, the exposed surface is to be treated with a preservative compound. When it is necessary to attach a crossarm to a new or old pole and a gain is not already available, a galvanized steel pole-gain is to be used. No pole is to be condemned and replaced without the evidence of a boring from an increment boring tool.

Details of oil and insulation tests

As a part of this maintenance schedule detail instructions are given for oil and insulation testing.

1. *Insulating Oil*—Extreme care must be taken to get representative oil samples. Clean and dry containers must be used and sampling under damp weather conditions avoided. Flush valve and pipe before sampling and draw off oil into glass container for inspection on free water, trash, sludge, etc.

A quart of oil is sufficient to fill the average test cup three times. If the first test shows better than 20 kv. no further tests are necessary. If the first test is less than 20 kv. at least three cup fillings should be tested from each sample and each filling tested three times. The average of the nine tests is to be taken as the dielectric strength. All tests are made with standard test gaps having 1-in. disks spaced one-tenth inch apart.

Oil which tests better than 20 kv. does not need filtering except to remove carbon or sludge. Oil which tests between 17.5 and 20 kv. should be filtered. Oil testing less than 17.5 kv. is to be considered dangerous and should be filtered at once. Circuit-breaker oil may be filtered with the breaker in service if the breaker cannot be taken out of service conveniently. Oil in transformers with conservator tanks may be filtered with the transformer in service if the oil is discharged from the filter press to the top of the conservator tank and provided the transformer cannot be taken out of service conveniently. All filter presses must be equipped with air chambers and care should be used to relieve the press from excess air after changing filter papers.

2. *Insulation Test of Transformers*—The accompanying tabulation indicates minimum insulation resistances considered safe for various transformers for several voltages and temperatures. The values are from windings to tank and the resistance between high- and low-tension windings should not be less than that between high-tension and tank. On certain types of transformers lower resistance values may be safe, but when these low readings are obtained they should be checked against other transformers of similar design.

The following tabulation is for average conditions:

Megohms at Various Winding Temperatures

Voltage of Winding	20-Deg. C.	30-Deg. C.	40-Deg. C.	50-Deg. C.	60-Deg. C. or above
66 kv. and above	1,200	600	300	150	75
22 to 44 kv. incl.	1,000	500	250	125	63
6.6 to 19 kv. incl.	800	400	200	100	50
6.6 kv. and below	400	200	100	50	25

In the event a transformer is found to have a lower resistance than the proper minimum the cause of the load reading is to be located and corrected immediately. If these attempts are not successful the transformer should not be returned to service without the approval of the division superintendent.

POWER COMPANY

Attended Substation Units Scheduled to Save Losses

In order to save several thousand dollars a year in substation transformer losses an Atlantic Seaboard utility employs a new loading schedule for attended substations. The number of transformers in operation is so co-ordinated with the load that the safe load which may be placed on any one unit will not be exceeded and at the same time transformer losses will be held to a minimum. Superimposed parabolic loss curves for different numbers of units are the basis for determining these schedules.

A typical distribution substation is shown in Fig. 1, with five 4,000-kva., three-phase, 26/4.15-kv. transformers. The loss curves for nominal 4,000-kva. units

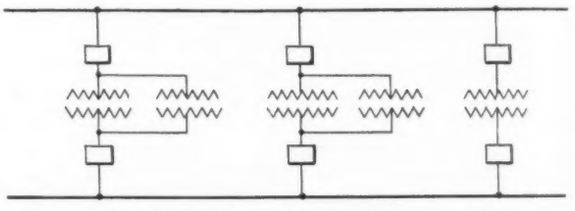


Fig. 1—Typical substation sketch shows the way 4,000-kva. units are added

Transformers are 26/4.15 kv.; when additional capacity is needed one more 4,000-kva. unit will be added to make three 8,000-kva. banks, etc.

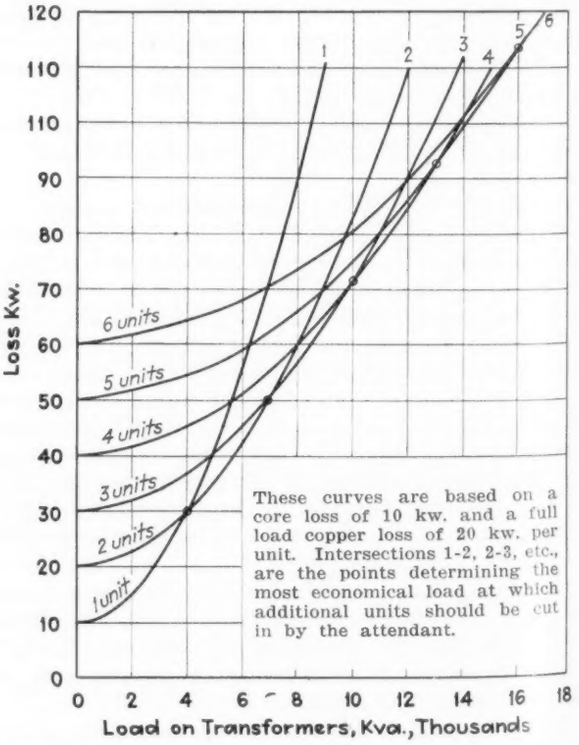


Fig. 2—Loss curves of 4,000-kva. transformers show most economical points for placing additional units in service

are shown in Fig. 2 and the transformer schedule is made up from these curves so that an additional unit will be cut in service when it becomes more economical from the loss standpoint to do so. According to an approximate schedule, if the load was in the range 0-9,000 kva., 12,000 kva. of capacity would be connected; from 9,000 to 13,000 kva., 16,000 kva. of capacity; 13,000 kva. and above, all 20,000 kva. would be connected. These are approximately the points at which it becomes most economical to change the number of units connected. The curve shows a transfer to be economical at 10,000 kva., but it was felt that 9,000 was enough overload to risk on the single 4,000-kva. transformer bank if for any reason the double bank were tripped out and the attendant was not able to cut in the spare unit in less than five minutes.

Protection Tests Scheduled

Two to ten weeks for rubber linemen's gloves in heavy service is the optimum period between laboratory retests; three to six months for gloves in occasional service by substation men and supervisors. These figures were cited by R. O. Bentley, division superintendent Public Service Electric & Gas Company, when discussing electric protective equipment before a recent Greater New York Safety Conference. Defective gloves are thus weeded out before they become dangerous and those which are passed are retested before they exceed their two months average life for line use. Inactive gloves usually have to be condemned for deterioration of the rubber after some eight to twelve months.

Rubber sleeves for protection of the arms are given a 10,000-volt test for three minutes by doubling them into a U, filling with water to form one electrode and immersing in a tank which constitutes the other. One company uses rubber overshoes for the protection of linemen's feet against accidental grounds in wet weather. Boots are more common. These receive a 10,000-volt test below the knee and 3,000 volt above. Neither shoes nor boots are relied upon particularly for electrical protection except to prevent discomfort from leakage current.

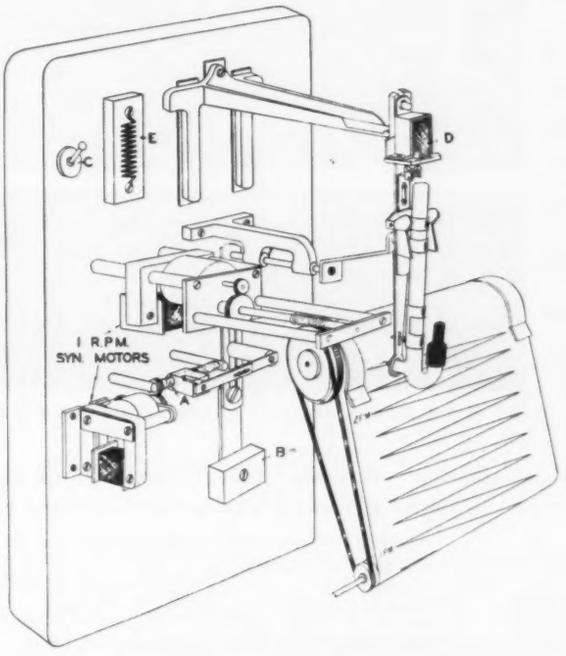
Graphic Meter Times System Disturbances

By E. A. LE FEVER and L. K. YERGER
Meter Department, Buffalo General Electric Company

Interconnection of large power systems requires a continuous and careful study of disturbances that occur from time to time. The locating of automatic oscillographs at important switching centers has been used to advantage in studying system stability. It is frequently important to have a record of the exact time of a disturbance. It is also very important to have an accurate time record when more than one oscillograph operation is recorded. There does not seem to be any moderately priced device available for making such an automatic record. To meet the requirement a simple device which is quite inexpensive to construct and maintain has been designed and has been in use for some time in the western division of the Niagara Hudson System. It is dependent upon regulated frequency.

The timer is so constructed that five minutes is required to drive the pen from zero to full scale over a chart $5\frac{1}{4}$ in. in width. The chart used is uniformly divided into 50 small divisions and ten major divisions, together with hourly timing on the left-hand margin. The chart is advanced 2 in. per hour, thus permitting a 250-ft. roll to run approximately two months. Time can be read to the order of three seconds. The accuracy is within six seconds on any position of the chart.

This device also has possibilities for use where it is desired to have an accurate automatic record of sequence of operations where the time is such that an oscillograph would hardly be practical.



Automatic oscillograph action timed to within three seconds by this device

A conventional graphic meter was dismantled, leaving the framework supporting the pen assembly and recording mechanism. A small synchronous motor with proper gearing is used to drive the metal drum which advances the paper. Another synchronous motor with proper gearing drives a reversible worm shaft *A*. A sliding bearing with a reversible steel dog is mounted on the worm shaft. As shaft *A* turns, this bearing moves from one end of the shaft to the other, and at the end of its travel reverses and repeats this cycle. The sliding bearing is mechanically connected to the pen arm through adjustable levers. By the use of proper gear ratios standard graphic paper may be used.

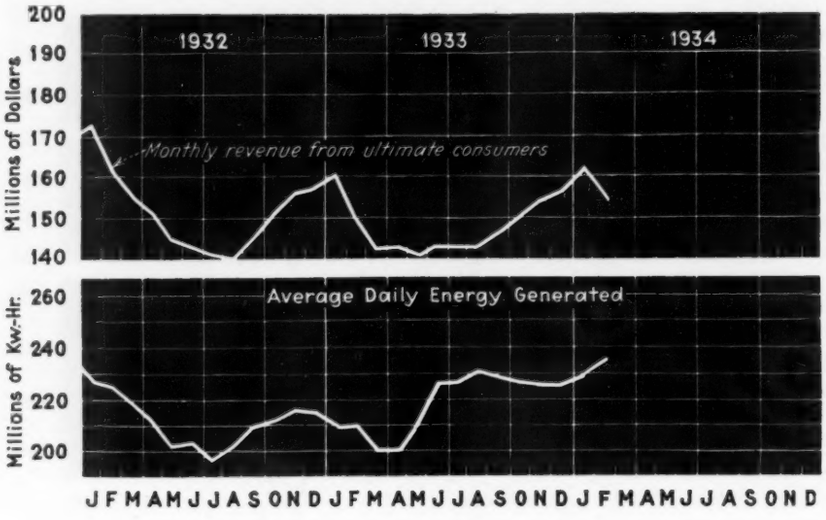
Electromagnet *D* with series resistor *E* is connected across the 6-volt motor which drives the automatic oscillograph. During the oscillograph operation electromagnet *D* lifts the recording pen approximately 1/16 in. and is held there until the oscillograph stops, after which the pen drops back to the normal position. The operation of this electromagnet in no way affects the time record, but leaves a very clear indication of the time at which the operation occurred.

Switch *C* is used to start both motors. *B* is a counterweight used to balance the moving system driving the pen assembly, thus reducing the friction on the reversible worm drive.

Electric Operations Gain Over 1933

February revenue, $154,831,700, rises 3.4 per cent over last year. Energy output up 11.2 per cent; industrial energy sales 26 per cent. Steam load increasing.

REGISTERING a further increase over the preceding year, revenue from ultimate consumers of electric light and power companies in February was 3.4 per cent higher than a year ago, against a similar increase in January of 1.1 per cent following several months during which there had been a relative decrease. This revenue amounted to $154,831,700, compared with $149,768,400 in February of 1933. Energy production, amounting to 6,579,573,000 kw.-hr., according to the U. S. Geological Survey, similarly increased by 11.2 per cent. This also marks an improvement over other recent months; the margin has been gradually broadening since November, when it was only 4.4 per cent.



Although total production was less during February than during January the average daily output for the short month, 235,000,000 kw.-hr., was nearly 2 per cent greater, which is an unusual occurrence. The normal change is a small decrease.

Only 32.5 per cent of the month's output was generated from water power, indicating a decrease of 15.7 from last year, while production from fuel was 31.5 per cent greater. The latter was larger than in either of the two long winter months, and when this calendar difference is taken into consideration it points to a decidedly heavier loading of the steam plants.

Industrial use jumps

The most striking feature of the upward movement was the expanding use of energy for industrial purposes, indicated by the 26 per cent increase in sales to large commercial customers. Not only was the relative rise over the preceding year larger than in January, when it came to 17.3 per cent, but the actual amount exceeded that of the longer month. Domestic energy sales were 3.2 per cent more in January than in the same month of 1933; this margin grew in February to 4.6 per cent.

Attention was called in the ELECTRICAL WORLD of March 31 to the distinction between sales to ultimate consumers only and the revenue figures formerly published, which included receipts from other public utilities for energy for resale. In 1932, according to the U. S. Census, the revenue from sales for resale amounted to $154,198,431, revenue from ultimate consumers was $1,821,105,524, total $1,975,303,955. The first named was 7.8 per cent of the total.

Table I—Monthly Revenue from Ultimate Consumers and Energy Output of Central Stations in the United States

Compared with Corresponding Month of Previous Year

Month 1934	Revenue from Ultimate Consumers		Energy Generated, Millions of Kw. Hr.*					
			Total		Hydro		Fuel	
	Thousands of Dollars	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc.
February	154,832	+3.4	6,580	+11.2	2,138	—15.7	4,442	+31.2
January	162,070	+1.1	7,171	+10.0	2,817	— 0.3	4,354	+17.5
1933								
December	156,127	— 0.9	6,989	+ 5.0	2,560	0	4,429	+ 8.3
November	153,980	— 1.8	6,788	+ 4.4	2,330	—12.6	4,458	+16.3

Table II—Regional Revenue, Energy Output, in February, 1934

Compared with Corresponding Month of Previous Year

Geographical Region	Revenue from Ult. Consumers		Energy Generated, Millions of Kw.-Hr.*					
			Total		Hydro		Fuel	
	Thousands of Dollars	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc.
United States	154,832	+3.4	6,580	+11.2	2,138	—15.7	4,442	+31.5
New England	13,624	+4.3	473	+22.8	168	—22.0	304	+79.0
Middle Atlantic	46,185	+2.1	1,777	+18.7	438	— 5.0	1,339	+29.0
East No. Central	36,133	+5.8	1,627	+20.0	118	—16.5	1,509	+24.3
West No. Central	13,101	+3.6	415	+ 0.3	81	—35.3	334	+16.0
South Atlantic, East So. Central	19,481	+3.1	756	— 0.3	288	—43.6	468	+89.0
			231	— 2.8	161	—20.4	70	+98.5
West So. Central	8,239	+3.9	308	+ 6.2	10	—56.4	299	+11.3
Mountain	4,236	+0.0	199	+13.5	156	+19.0	43	— 3.2
Pacific	13,833	+1.7	794	+ 6.4	718	+ 5.5	76	+14.4

*By courtesy of U. S. Geological Survey, with deductions for operations not regarded as central station.

Table III—Allocation of Energy, February, 1934

Compared with Corresponding Month of Previous Year

Class of Service	Millions of Kw.-Hr.	Per Cent Inc.
Total for distribution*	6,608	+13.2
Lost in transmission, etc.	842	+ 4.1
Sold to ultimate consumers	5,766	+14.7
Domestic	1,123	+ 4.6
Com'l, small light and power	1,085	+ 4.0
Com'l, large light and power	2,831	+26.0
Municipal street lighting	202	— 4.2
Railways—street and interurban	388	+11.5
Railroads—electrified steam	62	+24.1
Municipal and miscellaneous	75	+41.9

*Generated, purchased from other sources and imported less energy used in railway and other departments.

LETTERS TO THE EDITOR

When Manufacturers Disagree Regarding Motorization

To the Editor of the ELECTRICAL WORLD:

We are surprised that you would publish the article entitled "Plan Now for Desirable Air-Conditioning Load," by R. E. Hullmund, chief engineer of the Westinghouse Electric & Manufacturing Company, in the March 17 issue of ELECTRICAL WORLD. Surprised that you would publish statements so inaccurate even though submitted by an esteemed competitor, and that you would not realize before publishing that the types of motors Mr. Hellmund criticises adversely are the very types on which we have for years spent a substantial proportion of our advertising budget in your publications.

The following statement is inaccurate:

> For ratings of 5 hp. and above there is, of course, little doubt as to the use of polyphase power; however, the utilities should seriously consider whether it would not be advisable to furnish polyphase power even for the lower ratings, at least in those districts where there is reasonable promise of a more extensive use of air-conditioning equipment. Since the squirrel-cage motor does not permit speed adjustment, it will be necessary to take care of the varying load by starting and stopping the equipment and running it for varying periods of time, the same as is now done with refrigerators.

for the reason that multi-speed, squirrel-cage motors have been on the market for years providing two, three and four different speeds.

The last sentence of the following is particularly objectionable:

> While a three-phase system seems to offer the best solution in many cases, it must be kept in mind that there will be certain localities where the supply of three-phase power would be uneconomical. Therefore, equipment that can be operated by single-phase power must be available, at least for ratings below 5 hp.; either single-phase capacitor motors or repulsion-start, induction-run motors can be considered for this purpose. These at present are the simplest known types of motors, although neither of them is as desirable as a polyphase motor. In the capacitor motor equipment the motor proper is most simple and rugged, but slight complications in the control are necessary. In the case of the repulsion-start, induction-run motor the control is simpler, but the motor is equipped with commutator and brushes, with their inherent maintenance difficulties, and in addition special filtering equipment for eliminating radio interference may be necessary in many places.

Possibly the repulsion-start, induction-run brush-riding motors manufactured by Mr. Hellmund's company have inherent maintenance difficulties and cause radio interference, but the Wagner company has manufactured repulsion-start, induction-run, *brush-lifting* motors for forty years and has hundreds of thousands of them in service operating almost every conceivable type of motor-driven device, including air-conditioning equipment, and we are certainly not aware of their inherent maintenance difficulties.

We also manufacture the capacitor motors with which Mr. Hellmund compares the repulsion-start, induction-run motor and are in a position authoritatively to maintain that there are no more maintenance difficulties with the repulsion-start, induction-run, brush-lifting type motor than with the capacitor motor, and no reason, inherent or otherwise, why there should be. Undoubtedly, there are certain types of *brush-riding,* repulsion-start, induction-run motors subject to maintenance difficulties and radio interference, but Mr. Hellmund's statement is a broad condemnation of all repulsion-start, induction-run motors, including the outstandingly successful *brush-lifting* type of motor manufactured by ourselves and others. This statement is inaccurate and misleading, and certainly should be corrected by your magazine.

EDWIN H. CHENEY,
Vice-President.

Wagner Electric Corporation,
St. Louis, Mo.

Code Violation Noted in Range-Wiring Proposal

To the Editor of the ELECTRICAL WORLD:

Referring to the article "Range Wiring Costs Cut to $17," page 518, ELECTRICAL WORLD, April 7, 1934, we wish to call attention to a National Electrical Code violation in the diagram shown in the upper right-hand corner of the article.

The range frame cannot be grounded to the neutral conductor. See 1933 National Electrical Code, Article 9, Section 908f, page 138, last sentence, which says: "The grounded circuit conductor of an interior wiring system shall not be used for grounding circuit, cable armor, *equipment* and the like."

This would make the statement in the article, second paragraph, last sentence, which says "such a set-up is allowable under the code," erroneous. We believe this statement should be corrected and that it might be well for the author to study his code a little more carefully.

V. C. MOULTON,
Electrical Inspector.

Mountain States Inspection Bureau,
Denver, Colo.

Cable Guarantee Period Not the Whole Story

Disparity between the statements of D. S. MacCorkle in the March 10, 1934, issue of ELECTRICAL WORLD and of David Williams in a letter in the March 31 issue about cable sheath failures should not go unreconciled. In his paper as read at the A.I.E.E. meeting Mr. MacCorkle said: "All the lead sheath we *have* is not defective, trouble being confined probably to not more than 20 per cent of it." Mr. Williams in his letter showed that sheath defects attributable to the manufacturer during the "two-year *A.E.I.C. guarantee period*" were less than 0.2 per cent. Several failures occurring after the expiration of the standard guarantee period were included, but Mr. Williams recognizes that an indeterminable number of failures included in the classification "unknown causes" may be due to sheath defects. The purchasing engineer's primary interest is in securing conformity with specifications, while the operating engineer was talking of continued performance in service in addition to specification conformity.—EDITORS.

NEWS OF THE WEEK

Lehman's Reform Bills Become New York Law

Ten of the eleven Governor Lehman-sponsored New York utility reform bills have become law. "Their signing marks the end of a long struggle for the enactment of legislation which I and others have advocated over a long period of years," said the Governor in approving nine of the eleven measures this week. One bill had previously been signed, and the measure requiring competitive bidding on public utility corporation contracts involving more than $25,000 awaits expected favorable Senate action. The spectacular inferences drawn from the Senator Thayer-Associated Gas & Electric correspondence helped largely to bring to a swift conclusion the program ardently fought for by the Governor and as vigorously opposed by utility corporations for the past two years.

The ten measures approved by the Governor permit, with commission approval, competing municipal ownership of public utility plants; provide for turning over unclaimed customer deposits after fifteen years; authorize a $300,000 revolving fund to defray cost of Public Service Commission rate investigations, the ultimate cost to be assessed against the utility concerned; require commission consent for use of revenues by any utility for other than operating expenses, maintenance, payment of indebtedness with interest and dividends to stockholders; allow villages owning their own gas and electric plants to furnish service in outlying territory, subject to approval at a referendum; empower the Public Service Commission to order temporary rate reductions to a point where a utility corporation would earn not less than 5 per cent on its property used or useful in the public service, less depreciation; provide fees to be charged and collected by the commissions; limit management and engineering charges between affiliates; define an affiliate to include any interest owning 5 per cent or more of capital stock; and place gas transmission lines under commission regulation.

T.V.A. Starts Merchandising Plan

Advertising campaign arranged. Appliance emblem selected. Lilienthal demands new utility leadership, predicts vast industrial expansion of Tennessee Valley.

WITH sale of appliances approved by the Electric Home and Farm Authority scheduled to begin in Tupelo, Miss., early next month, large scale advertising activities will be conducted by the Tennessee Valley Authority in the seven states to be served, under a contract entered into by the authority this week with Young & Rubicam, New York advertising agency. Promotional work will start May 1 and will concentrate on stimulation of energy and appliance use in the Tennessee Valley.

A special T.V.A. emblem to be placed on all appliances sold under the E.H.F.A. has been selected. Consisting of a blue hand holding a lightning bolt in red, with T.V.A. in large red block letters below the hand, the emblem will first be used on the electric ranges, refrigerators and water heaters now being manufactured for the program. Eventually it will be placed as an identifying mark on all equipment of this branch of the authority and throughout the power department of T.V.A. Coincident with appliance sales in Tupelo, sales will begin also in areas served by the operating companies of Commonwealth & Southern Corporation, which has an appliance agreement with the authority.

Predicting that private ownership of public utilities can survive only under a new leadership, and visioning a vast industrial expansion in the Tennessee Valley, David E. Lilienthal, director of the Tennessee Valley Authority, reported to the League of Women Voters at Boston, Mass., and the Tennessee Valley Institute, at Chattanooga, Tenn., the progress and aims of T.V.A. this week and last.

His Boston listeners heard Mr. Lilienthal assail the alleged efforts of utility interests to block T.V.A.'s development and enumerate four changes of "immediate and pressing importance" essential if private ownership of public utilities is to survive and flourish. A "real house-cleaning in the industry," which would mean "no mere change of names"; cessation of utility opposition to "every reasonable effort to strengthen regulations"; a writing off of that portion of the utility capital structure which does not represent value, and "a wholehearted recognition of the right of the people to serve themselves with electricity, if at any time they are dissatisfied with service through a private agency," are essential, he contended.

T.V.A. considers four more dams

Four more major dams will probably be approved by T.V.A. for early construction, Mr. Lilienthal told the Tennessee Valley Institute, in predicting an unprecedented industrial expansion for

the valley. He cited the electrochemical and electrometallurgical industries as typical of the divisions of industry that will be attracted to the valley, since they cannot now profitably operate because of high rates. Reduction in power costs, Mr. Lilienthal noted, will be an important factor in the textile industry, one of the foremost in the industrial life of the section.

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New York Inquiry Voted

Senate approval was forthcoming last week for the state-wide inquiry into public utilities demanded by Governor Lehman of New York.

Authorizing a thorough investigation into the relationship of utilities to legislation, their financing and alleged lobbying activities, the measure, previously approved by the Assembly, appropriates $250,000 for the work of the committee of legislators who will conduct the probe. A report is required by February 15, 1935.

New York City will impose a 1 per cent tax on the gross income of utility corporations, as well as a tax of one-twentieth of 1 per cent on gross incomes of businesses in the city above $10,000 a year, under a measure approved by the Legislature this week. Prompt approval from Governor Lehman is expected.

Electrical Contractors' Code Signed

Supplemental code for electrical construction approved by President. To go into effect April 30. Utility construction not affected. New work in factories is covered.

THE supplemental code of the electrical contracting division of the construction industry was signed last week by President Roosevelt and becomes effective on April 30. This code embraces "the erecting and installing, altering, repairing, servicing and maintaining of electric wiring devices, appliances or equipment, including the purchasing from suppliers and the selling of manufactured parts and products incorporated in such installation."

The basic provisions of Chapter I of the code of fair competition for the construction industry establish 40 cents per hour as the minimum wage for ordinary workers and a minimum salary for clerical employees, ranging from $12 a week in towns of less than 2,500 to $15 in cities of over 500,000 population. To this the electrical contractors' supplemental code adds, for the first time in the construction industry, a minimum wage for skilled workers of not less than 75 cents an hour. There are the usual trade practice clauses and the schedule basis for figuring costs, which still lists the ambiguous condition that overhead expense should exclude items of selling expense, but specifies that estimating expense shall not be considered as selling expense.

Divisional authorities to be set up

Seventeen divisional code authorities will be organized and industry statistics will be compiled on the number of employees, man-hours and payrolls. When the divisional code authority determines that an emergency exists, due to destructive price cutting, it may cause to be determined the lowest reasonable cost of the products of the industry. Thereafter during the period of the emergency it shall be an unfair trade practice for any member of the industry to sell at such prices, terms or conditions that the buyer shall pay less than the lowest reasonable cost of such products. No member under the code shall change his bid price except for variation in wages, material prices or substantial changes in the original plans or specifications and then only to an extent consistent with the actual changes of cost involved. No member shall submit a competitive bid to an owner unless the owner agrees to comply with the regulations governing competitive bidding. This has interesting possibilities. Every bid of over $250 calls for a deposit to be lodged with a local bid depository.

An open price plan is established on the usual basis. If the divisional code authority determines that it has been a generally recognized practice to conduct this business on the basis of printed net price lists for price lists with discount sheets and fixed terms of payment, which are distributed to the trade, net price lists or price lists and discount sheets shall be filed with the local administrative committee, individually prepared by each member showing his current prices and discounts in terms of payments. Divisional code authorities shall immediately send copies to all members engaged in the business in that trading area and shall make same readily available to buyers or prospective buyers who desire them. No member of this division shall offer any lower price or greater discounts or more favorable terms than those provided in his current price list.

Code exceptions are significant

Exceptions to the code of the electrical contractors will be of special interest to the other branches of the electrical industry. For example, this code will not apply "to work for telephone or telegraph service, where such work is an integral part of the communication system owned and operated by a telephone or telegraph company in rendering its duly authorized service." It shall apply to "the installing of telephone and telegraph cables and wires, in raceways or conduits in buildings in the process of construction, where such work is performed by others."

Utility construction exempted

This code will likewise not apply "to electrical work for the generation and primary distribution of electric current, or the secondary distribution system ahead of the meter, where such work is an integral part of the system owned and operated by an electric light and power company in rendering its duly authorized service, is done by such a company's own employees, and/or is work on customers' premises necessary for the rendering of safe and continuous service." But it shall apply to "the installation, permanent alteration or repair, or maintenance of electric wiring, devices, appliances or equipment of private owners other than an electric light and power company not elsewhere excluded." These provisions shall also not apply to "the sale or rental of electrical signaling apparatus or systems for protection against fire, burglary or robbery or to the servicing of such signaling apparatus or systems, where such work is an integral part of such a system, owned or maintained by an individual, firm, corporation or other form of enterprise engaged in such business."

Provisions of this code will also not

THE HALF-WAY MARK FOR BOULDER DAM

Wide World

Half-completed, here is Boulder Dam as it looks today. Since June, 1933, more than 1,600,000 cubic yards of cement have been poured into the dam to raise it to 300 feet of its eventual 732-ft. height. In the foreground is shown construction work on the generating station, from which in 1935 the first unit will deliver 41,000 kw. In November the upstream cofferdam will be removed so that storage of water behind the dam may begin.

Coming Meetings

National Fire Protection Association—Atlantic City, N. J., May 14-18. A. R. Small, 109 Leonard St., New York.

American Institute of Electrical Engineers—Northeastern District meeting, Worcester, Mass., May 16-18. Summer convention, Hot Springs, Va., June 25-29. H. H. Henline, 33 W. 39th St., New York.

National Electrical Manufacturers Association—The Homestead, Hot Springs, Va., May 21-24. A. W. Berresford, 155 East 44th St., New York.

Edison Electric Institute—Atlantic City, N. J., June 4-7. B. F. Weadock, 429 Lexington Ave., New York.

Canadian Electrical Association—Annual convention, Seigniory Club, P.Q. (Lucerne-in-Quebec). June 13-15, B. C. Fairchild, 409 Power Building, Montreal, Que.

American Society of Mechanical Engineers—Semi-annual meeting, Denver, Col., June 25-28. Calvin W. Rice, 29 W. 39th St., New York.

apply "to manufacturing or assemblying in the manufacturer's plant, nor to servicing or repairing of electrical apparatus, appliances or equipment by a manufacturer or by an electric shop," but shall apply to "the installation of all new electrical work on the customers' premises not elsewhere excluded." An electric repair shop for the purposes of this paragraph shall mean "an establishment engaged in the repairing, rewinding and reconditioning of motors, generators and transformers and other electrical apparatus."

The code will also not apply to "the maintaining, servicing or repairing of existing installations of electric wiring, devices or equipment, or the moving or relocating of equipment in a plant or property, performed by an owner or tenant, not for hire, individually or with his permanent employee or employees for electric maintenance work within his property." But it will apply to "the installation of all new electrical work not elsewhere excluded." The term permanent employee in this paragraph is confined to "any employee who is regularly and continuously employed or who has been so employed by any such owner or tenant within such owner's or tenant's own plant or property for a period of not less than six months." This means that factory electricians employed for periods less than six months or on the installation of new work must be paid the full contractor's wage. This may have an important influence upon the volume of industrial business that will hereafter flow to the local contractor.

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New E.E.I. Medal

Designed for presentation to employees of member companies, a medal for resuscitation from electric shock by the prone-pressure method has been established by the Edison Electric Institute. The medal was authorized by the operating committee of the institute last November and its presentation is intended to serve both as a recognition of successful resuscitation and to encourage interest in the prone-pressure method. It is planned to announce the initial awards at the Edison Electric Institute convention in June. The medal will have in its composition copper of historical and sentimental interest to the industry, being part of the original mains laid down in New York City by the late Thomas A. Edison. The copper was donated by New York Edison Company.

Symbol Standards Issued for Power and Wiring

New standards covering graphical symbols for electric power and wiring, radio and electric traction, including railway signaling, are now available in printed form, the American Standards Association has announced. The standards were prepared under the sponsorship of the American Association for the Advancement of Science, American Institute of Electrical Engineers, American Society of Civil Engineers, American Society of Mechanical Engineers and Society for the Promotion of Engineering Education.

The symbols for electric power and wiring comprise those used for one line and complete diagrams of electric power apparatus, instruments and relays, and maps and connection diagrams. They are limited to apparatus usually encountered in electrical power engineering, such as major electrical equipment in power houses, substations, transmission and distribution systems, and to system wiring diagrams. A list of 50 radio symbols covering tubes, transformers, condensers, inductors and similar apparatus comprises the radio standard. More than 470 graphical symbols used for diagrams for electric traction and railway signaling, such as electrical equipment in power houses, substations, transmission and distribution systems; electrical equipment of electrically operated cars and locomotives, and electrical equipment and associated equipment used in railway signaling, are included in the traction and signaling report.

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To Address U. S. Chamber

"Problems of Enlarging the Electric Power Market" will be the subject of an address by Samuel Ferguson, president of the Hartford (Conn.) Electric Light Company at a round-table meeting to be held during the annual meeting of the Chamber of Commerce of the United States, in Washington, May 1-4. The round-table discussion will deal with the problems of the "Natural Resource Industries" and will include addresses on lumber, oil and coal industry problems.

N. Y. Association Protests Conditional Sales Bills

With the statement that proposed amendments to the state personal property law in relation to conditional sales agreements would "leave the seller at the mercy of the purchaser," the Electrical Association of New York has voiced vigorous protest against the passage of this legislation.

Two bills, now before the Senate judiciary committee would permit cancellation by the purchaser upon written notice and return of the goods in good condition, and would restrain the seller from any action to recover the balance due on the contract. The second measure would pass the title of goods purchased under a conditional sales agreement to the purchaser after 75 per cent of the purchase price had been paid.

N.E.M.A. QUOTAS?

That the code authority for the electrical manufacturing industry be given power to allocate among domestic manufacturers import quotas established by foreign countries is a proposal gaining strong support in government and trade circles. Under such a plan a better distribution of export business would be possible. Following the lead of France, many countries are resorting to the quota system. Those interested in the development of American foreign trade urge that the code authority is the best medium to do foreign trade planning for the industry and should be just as interested in the situation abroad as in this country. It is further argued that a program to meet foreign trade revival should be prepared during the lull.

The Johnson bill proposing to restrict the jurisdiction of federal courts in utilities cases is not having as clear sailing in the House as it had in the Senate. Not only did the House judiciary committee report out a much different bill, but it was only with difficulty that a rule for the consideration of the measure was obtained. No date for House action has been set.

As yet the Federal Power Commission has made no announcement concerning the results of conferences with representatives of municipal and private power plants consulted concerning the general power survey and census of electrical rates. Information concerning these conferences will be released after all have been concluded.

Use of new copper to a very large extent is forced by the newly adopted copper code. The plan provides for the freezing of existing stocks above ground, with certain exceptions, and contemplates the use of newly mined "Blue Eagle" copper by all industries operating under codes.

PAUL WOOTON,
Washington Correspondent.

4,000 Kw. of Lighting for Ford Fair Exhibit

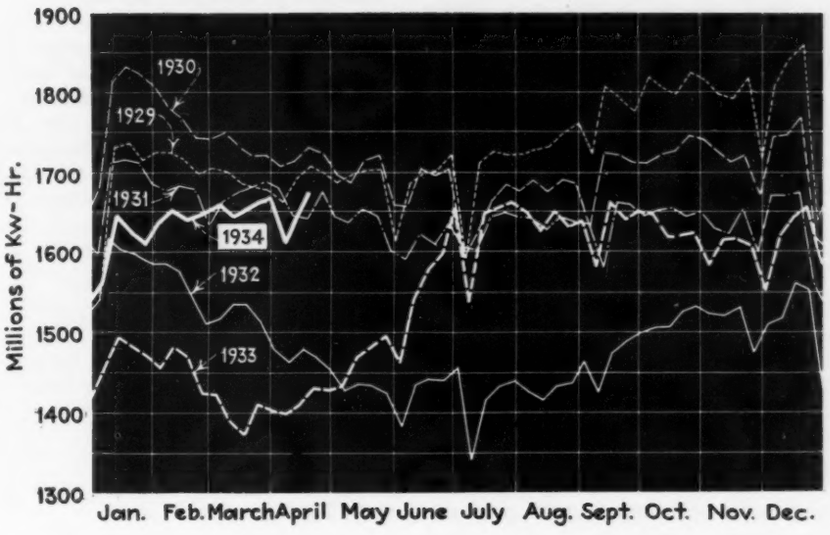
More than one-third of the electrical capacity of last year's World's Fair will be required by the Ford Motor Company project at the 1934 Century of Progress Exposition in Chicago. Two-thirds of the 6,000 kw. load will be utilized for exhibition lighting and unusual lighting effects. In all there will be more than 225 electric motors and 9,000 concealed floodlights in the lighting display of shifting kaleidoscopic patterns. An amplifying system will contain more than 750 loudspeakers of low power designed to disguise the effect of the amplifier system by eliminating objectionable blare near the speakers. More than one hundred miles of electric wiring will be employed.

The huge court of the building will be lighted externally by more than 22,000 lineal feet of lighting units, each foot of which will contain one 200-watt blue, one 150-watt green, and one 100-watt red lamp. Similar lighting will be used inside the court. An unusual lighting feature of the fair will be a beam of light 200 feet wide, springing from the parapet of the open court and formed by 24 thirty-six inch projector searchlights of 30,000,000 candle power. The torch of light will rise more than one mile when the weather permits. The exhibition section to be divided among the various Ford divisions and 21 associated exhibitors will be provided with approximate daylight by combinations of high-pressure mercury and "Mazda" lamps.

Special transformers required

The power load of some 2,000 kw. will be made up of 75 building motors, 150 motors in the various exhibits, and by the small foundry and welding exhibition. The foundry will require a special transformer and will be rated at 250 kva. Two 350 kva. welders and 300 kva. of smaller welders will be used. Several 100 hp. motors will be employed in a steel rolling mill and miniature tire factory. Two main transformer banks will supply power and lighting current, and a third the foundry and other units.

Output Sets 1934 Record



Records were broken by the output of electric light and power plants during the week ended April 21. It amounted, according to the Edison Electric Institute, to 1,672,765,000 kw.-hr. It was the largest thus far in 1934. It surpassed that of any week during 1932 and 1933. It exceeded that of the corresponding week last year by 16.9 per cent, two years ago by 13.7 per cent and three years ago by 2.0 per cent, breaking through the curve for 1931. It fell short by only 2 per cent of matching the week in 1929 and 3.5 per cent of 1930, which was the year with the highest spring-time production.

Leading in regional increase over 1933, the Central industrial part of the country again gained 22.4 per cent. The Middle Atlantic area further increased its margin over 1933, to 13.3 per cent. Other sections continued at about the same high proportionate excess as in other recent weeks.

Weekly Output, Millions of Kw.-Hr.

1934	1933	1932
Apr. 21...1,673	Apr. 22...1,431	Apr. 23...1,470
Apr. 14...1,642	Apr. 15...1,410	Apr. 16...1,481
Apr. 7...1,617	Apr. 8...1,399	Apr. 9...1,465
Mar. 31...1,666	Apr. 1...1,402	Apr. 2...1,480
Mar. 24...1,658	Mar. 25...1,410	Mar. 26...1,515

Per Cent Change from Previous Year

Region	Week ended Apr. 21	Apr. 14	Apr. 7
New England	+15.7	+16.5	+16.0
Middle Atlantic	+13.3	+12.5	+10.5
Central Industrial	+22.4	+22.4	+21.3
West Central	+11.2	+10.2	+11.0
Southern States	+16.5	+15.5	+14.3
Rocky Mountain	+20.4	+16.8	+20.8
Pacific Coast	+13.3	+14.3	+12.9
United States	+16.9	+16.5	+15.5

French Test Sodium Lamps

To compare sodium vapor lamps with filament bulbs for street lighting under similar conditions two sections of the Paris-Versailles highway have been so equipped. For the first 4,900 ft. of the highway 31 electric lamp-posts 26 ft. high have been placed at intervals of approximately 130 ft., each equipped with one two-filament, 150-volt a.c. "Mazda" lamp for 500 or 200 watts output. The first filament is used from nightfall to midnight and the other for the remainder of the night. The second stretch of 11,500 ft. is lighted with 85 lamp-posts, each equipped with two Phillips 100-watt sodium vapor lamps for 700 volts d.c. operation. The sodium vapor installation is said to have been very costly, but on a larger scale the cost would be reduced. If successful other highway installations of sodium lamps will be made.

Palestine Has Record Year

Anticipating an increase of 7,000 customers over those served in 1932, due to the completion of the Jordan hydro-electric plant and rapid progress in industrialization during the past year, Palestine Electric Corporation reports as of 1933, 22,000 customers using a total of 20,000,000 kw.-hr. annually. This compares with the 1927 figure of less than 8,000 customers and a use of but 2,500,000 kw.-hr. a year.

South African Station

Plans for erection of a 350,000-kw. generating station at Vereeniging, South Africa, have been announced by the South African Electricity Supply Commission. Cost of approximately $8,750,000 is estimated for the complete installation, but a plant with capacity of 106,000 kw. will first be built at a cost of $5,000,000. Victoria Falls Power Company will co-operate with the commission in construction of the plant.

British Output Increases

Energy output for the United Kingdom during the month of March was 1,390,000,000 kw.-hr., an increase of 19.6 per cent over the figure recorded for March, 1933, according to a statement issued by the British Electricity Commission. First quarter output stands 16.9 per cent ahead of the same 1933 period.

As to Rates——

• Public Service Company of Indiana has been ordered by the state Public Service Commission to reduce its electric rates in 270 cities and communities. Through this sweeping order, effective May 1, the utility company will lose $1,000,000 annually in revenue. Reductions were provided for all residential, commercial and power consumers, except in instances where special low-rate power contracts remain binding. The commission instructed the company to file monthly reports on operations under the new rates showing gross and net operating revenues, total electric sales, total operating expenses and disbursements. The commission made no percentage estimate on the reductions, but declared the rates would be fair and would yield the company a 6 per cent return on a valuation of $43,500,000 for its electric property. The company had placed a valuation of approximately $51,000,000 on the property. Officials of the company declined to make statements until they had studied the order.

• Philadelphia Electric Company's rate case, resumed last week so that the Public Service Commission might sift charges that increases were caused to some consumers under the new rates, was halted abruptly when City Controller S. Davis Wilson objected to evidence that the utility company presented as being irrelevant and an evasion of the issue. Before the hearing is continued, the full commission will pass on Mr. Wilson's objection and will also issue a ruling governing the order of testimony to be presented by the company and the degree to which testimony not bearing directly on increases may be admitted. By ruling of the Pennsylvania Supreme Court, the electric company was under obligation to justify whatever increases resulted under the new rates, Mr. Wilson contended, demanding that the commission strike from the record all of the testimony presented by the company which analyzed decreases in current bills to certain complainants who had joined with Mr. Wilson in the protest.

• Lexington Utilities Company and the Kentucky Utilities Company have announced reduced rates for consumers having full residential electric service retroactive to April 1. The new rate will be $2.50 net per month for the first 30 kw.-hr. or any part thereof, 4 cents per kilowatt-hour for the next 100, and 2 cents per kilowatt-hour for all additional use.

• Seattle (Wash.) City Council has voted to pass the ordinance of Ralph D. Nichols, finance chairman, reducing the charge for city light energy for residential use from 1 cent to 7½ mills for each kilowatt-hour in excess of 240 used in one month. This new rate had the approval of City Light Superintendent J. D. Ross, but upon his request the utilities committee deferred action upon Mr. Nichols' proposal to reduce the rate for residence lighting from 5½ cents per kilowatt-hour for the first 40 kw.-hr. to 5 cents. Mr. Ross has asked that such a reduction be given no consideration until the Diablo plant at the Skagit is completed.

Illinois Voters Reject Two Municipal Plants

After a campaign that was vigorously fought, citizens of Waukegan voted last week, 4,927 to 1,565, against taking even a tentative step toward the acquisition of an electric power plant to be operated by the municipality. Voters were asked to decide whether the City Council should appropriate necessary funds to obtain data to be used in the preparation of an ordinance for the construction or purchase of a plant. The proposition provided that the plant would have to be financed by the issuance of certificates redeemable solely from the revenues to be derived from its operation. Waukegan is served by the Public Service Company of Northern Illinois.

Murphysboro, Ill., for the second time voted against a proposition to build a publicly owned power plant. The majority against the proposal was 1,212.

Iowa City Votes Plant; Rockford Election May 15

By a vote of 2,955 to 2,810 City Council of Iowa City, Iowa, was authorized by the citizens to purchase for not more than $917,000 an electric light plant and establish municipal ownership and operation. Should a federal loan and grant be refused, the city, under the Iowa Simmer law, is empowered to purchase the plant of the Iowa City Light & Power Company and pay for its costs from earnings, the Iowa law also providing for erection of municipal light and power plants to be paid for from earnings. The Iowa City Light & Power Company has been furnishing current since January 1, when its franchise expired and no renewal was granted.

City Council having canceled contracts with the Fairbanks-Morse Company under previous awards at the request of the company, the town of Rockford, Iowa, will vote again on May 15 on the proposition of constructing a municipal light and power plant. The Iowa Public Service Company, which now serves the city, has a federal court injunction action now pending against officers of the town to prevent construction following the first election. City Council voted April 16 to table an offer of the utility company to lower rates.

Public Right Transcends Utility Franchise Grant

In a far-reaching decision handed down last week the United States Circuit Court of Appeals in St. Louis maintained that the right of a municipality to construct an electric light and power plant transcends the franchise rights of a private utility company already serving that municipality. By its decision the court reversed the Eastern United States District Court of Arkansas, which had issued an injunction enjoining the city of Paragould, Ark., from building such a plant because the city had granted franchise to the Arkansas Utilities Company.

"When private rights of an indefensible nature are sought to be derived from regulatory powers," the decision read, "the case is peculiarly one for the application of the universal rule that grants of special rights and privileges are to be strictly construed in favor of the public right, and nothing is to be taken for granted concerning which any reasonable doubt may be raised."

Public Ownership Limited by Indiana Court Ruling

In a recent ruling, which cast a veritable bombshell into the ranks of the protagonists of public ownership of utilities in Indiana, Special Judge Walter S. Bent in Superior Court held that the 1933 act of the Legislature giving municipalities the right to take over, by certain procedure, public utilities doing business in cities and within 6 miles of the city, though constitutional, is not retroactive as to utility companies engaged in business prior to the enactment of the law and operating under the 1915 acts, which, he said, vested them with certain rights. These rights, Judge Bent maintained, cannot be taken away, and any action by a city to gain ownership of the utilities must be in accordance with the earlier law, which did not provide for an election.

The case under discussion involved the city of Muncie and the Indiana General Service Company, which brought suit against the city to restrain it from holding an election. The Superior Court action has no jurisdiction in any county but the one in which it was given, but the moral effect has been tremendous. In many places elections already have been held and in other cities elections are pending. There is little doubt that the state Attorney-General will have the case appealed to the Indiana Supreme Court.

FINANCIAL · · · BUSINESS

North American Head Sees Expansion Era

While substantial additional output can be provided with the present generating capacity, "any additional large increase in business above present levels will necessitate expenditures for additional transmission and distribution facilities," James F. Fogarty, president of North American Company, told stockholders at their annual meeting this week. This is one of two primary conditions which favorably affect the prospects of the company's subsidiaries, Mr. Fogarty said. The other is that the rates of subsidiaries are low, domestic consumers paying an average price of 4.2 cents per kilowatt-hour, compared with the national average of 5.5 cents.

Capital expenditures not a problem

Pointing out that the cash position of his company is such that expenditures for additional equipment would "impose no great burden upon our facilities," Mr. Fogarty said that increased business could be handled with a comparatively small increase in investment charges and should be reflected to a greater degree in net earnings.

North American subsidiaries now have the greatest number of residential customers in the history of the group, Mr. Fogarty asserted, and the energy output of the companies for the first quarter was larger than for any three-month period since 1930.

The report for the year ended March 31 shows a consolidated net income of $11,498,865 after all deductions, equal after preferred dividends to $1.19 a share on 8,110,132 average number of common shares outstanding during the period, comparing with $13,964,663, or $1.63 a share, on 7,441,771 average common shares in the preceding year.

Northeastern P. S. Offers Reorganization Plan

Option to buy for $40 in cash $50 principal amount of debentures and 1¼ shares of common stock will be granted holders of Northeastern Public Service Company general lien and collateral trust 5½ per cent bonds, under the reorganization plan submitted last week to the Delaware Chancery Court. The plan also provides for exchange of eight shares of preferred stock and two shares of common stock in a new company for each $1,000 of bonds held. Holders of preference, preferred and common shares of the old company may buy such units.

The Chemical Bank and Trust Company, owner of the entire $4,670,000 first lien and collateral trust 5½ per cent bonds of the Northeastern Company, will own six-sevenths of the common stock of the proposed new company when the reorganization plan is effected. In exchange for approximately $600,000 in cash and its first lien bonds, the bank will receive $6,000,000 of twenty-year debentures of the new company and 150,000 common shares. The plan calls for the issuance of $6,000,000 new debentures, 93,447 shares of $4 preferred stock and 173,362 common shares and such additional debentures and common shares as may be acquired by the general lien bondholders under their option.

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Associated Gas Sued

Another in the long list of receivership suits by small stockholders of Associated Gas & Electric Company was initiated this week by Lillian Russell Meehan of Towanda, Pa., in federal court at Utica, N. Y. Asserting that because of Associated's "diversion of funds and financial chaos" it has been "necessary for the national and state authorities to institute investigations," the suit alleges that the Associated company and its subsidiaries "are in a precarious financial condition by reason of stock manipulation and diversion of assets." Officials of Associated, expressing ignorance of the character of the action, stated that the suit "is doubtless in line with other receivership applications which have been made over the past two years and which in every case have failed."

Westinghouse Billings Up 36% in First Quarter

Although improvement in its business is most encouraging, the Westinghouse Electric & Manufacturing Company "would view the future with more optimism if the present restrictions curtailing and almost preventing the use of long-time credit were removed," the company told its directors at a meeting late this week.

An increase of 36 per cent in sales billed for the first quarter was the result of the largest activity during March of any month since April, 1932. Although first quarter orders were $20,237,588, compared with $12,847,801, a gain of 57 per cent over the same quarter last year, a net loss of $1,776,152 resulted from operations. This compares with a net loss of $3,491,572 in the first 1933 quarter. March sales were the largest for any month since 1931.

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Allis-Chalmers Loss Cut

A 10 per cent increase for more than 4,000 employees of Allis-Chalmers Manufacturing Company preceded the announcement this week that first quarter operations of the company had resulted in reduction of its net loss to $677,153, compared with loss of $869,986 for the same 1933 period. Unfilled orders on hand March 31 were $7,725,271, against $6,425,998 on December 31 and $4,470,399 on March 31, 1933.

Effect Federal P. S. Plan

Federal Public Service Corporation's plan of reorganization (ELECTRICAL WORLD, December 2, page 711, and March 10, page 385) has been declared operative by the reorganization committee, according to M. M. Bogie, chairman. The small minority of security holders who have not yet deposited under the plan will be given until the close of business May 19 to deposit their holdings.

American Cities Dividend

Resumption of dividends on its class B stock was voted last week by directors of American Cities Power & Light Company in declaring a disbursement of 10 cents a share on April 30. The last previous payment was 15 cents a share on February 10, 1933.

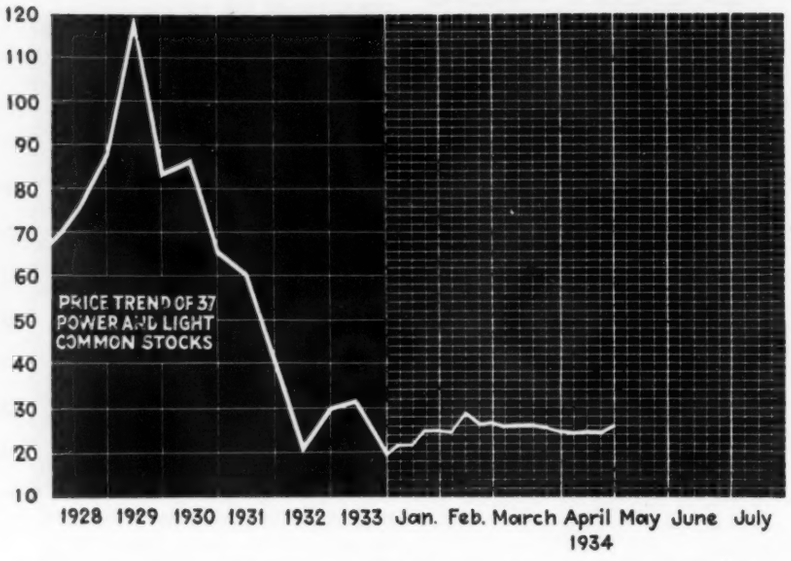
OPPORTUNITY

Business, long harried by reform motives and reformers, may, it is now rumored, be given a semblance of opportunity to show what it can do to achieve a more or less orthodox recovery in the next few months. Perhaps the difficulty in devising large-scale plans for capital-goods-industry recovery, though the necessity for gains there is fully recognized, lies behind the new, and albeit as yet quite cautious, move. Behind the first stirrings of altered viewpoint remains the long-standing threat of broader inflation should results be inadequate.

Telltales of the week show a sustained upward trend. Energy output for the week ending April 21 set a 1934 high and came close to the all-time peak for the third week in April. Steel activity, stimulated by rail buying, rose sharply. Carloadings increased 3.8 per cent over preceding week. Automobile output up slightly.

Prices, in reactionary drift, turned downward under marked weakness in grains. Stocks and bonds lost some of the previous week's gains.

Utility Stocks Advance Slightly



Although stock price movements during the week were, generally speaking, narrow, utility shares advanced sufficiently to carry the "Electrical World" index to 26.1, as compared with 25.2 last week.

National P.&L. Offers Aid to Birmingham Utility

With the request that its offer not be construed as "an admission of illegal payment or receipt of dividends," National Power & Light Company has proposed to the Alabama Public Service Commission a program of financial rehabilitation for the Birmingham Electric Company, by which it will subordinate its claims on the operating company, advance it cash for dividend, construction, and capital requirements, and accept common stock for its advances. Preferred stockholders of the Birmingham Electric Company had previously secured an attachment of $3,200,000 against the holding company, alleging illegal transfer of funds from the operating company to its parent. The commission had subsequently issued orders looking toward the attempted recovery of these funds (ELECTRICAL WORLD, March 17, page 421).

The essential terms of the offer as presented by S. R. Inch, president of National Power & Light Company, include such steps by the parent company as are necessary to enable Birmingham Electric to reduce the stated value of its outstanding common stock by approximately $12,000,000; acceptance of common stock of the operating company in lieu of its present debt to the holding company, amounting to $1,254,590; payment of $430,000 to the Birmingham utility, representing the approximate amount of preferred dividends now in arrears; advance of up to $500,000 for street railway and bus equipment expenditures by Birmingham Electric Company; furnishing of up to $200,000 for 1934 additional capital expenditures; and acceptance for such advances as it may make of junior securities of the operating company. The Public Service Commission has the matter under advisement and its ruling is expected shortly.

Moloney Electric Loss

Net loss of the Moloney Electric Company for the year ended December 31, 1933, totaled $145,283 after all charges, as against net loss of $136,718 in the previous year. Current assets amount to $1,318,140 and current liabilities to $32,793, assets including $579,242 cash, as against cash and certificates of deposit a year previously of $548,497; receivables of $144,649, as against $143,076; inventories of $594,247, as against $645,877. Bonded debt stands at $1,240,000, or $25,500 less than a year ago.

Canadian Westinghouse

Sales of merchandising appliances for household use by the Canadian Westinghouse Company showed a considerable gain during 1933, according to a statement made at the recent annual meeting of the company by Paul J. Myler, chairman and president. The sales of this class, including lamps, amounted during the year to more than one-half of the total sales volume. "Our selling efforts in the refrigerator field," Mr. Myler said, "were particularly successful."

Kelvinator Profits Rise

Net profit of the Kelvinator Corporation for the quarter ended March 31 amounted to $305,517 after depreciation, interest, federal taxes, etc., equivalent to 28 cents a share on 1,106,041 shares of no-par common stock. This compares with net loss of $341,935 in the preceding quarter and net loss of $330,688 for the first quarter of 1933.

Current Earnings Reports of Electric Light and Power Companies

Operating Companies

	1934	1933	Per Cent Increase	Operating Ratio 1934	Operating Ratio 1933
Detroit Edison (Year ended March 31)					
Gross earnings	$42,620,832	$42,216,549	0.9	68	72
Net earnings	13,333,575	11,740,861	13.6		
Net balance*	6,921,111	5,547,607	24.6		
Duquesne Light (Year ended January 31)					
Gross earnings	24,080,431	24,939,274	— 3.4	45	43
Net earnings	13,245,322	14,051,148	— 5.7		
Net balance*	10,671,829	11,592,219	— 8.0		
Puget Sound Power & Light (Year ended February 28)					
Gross earnings	12,662,093	13,212,799	— 4.2	66	61
Net earnings	4,338,812	5,158,560	— 15.9		
Net balance	1,419,530†	160,882	—986.0		
Virginia Electric & Power (Year ended February 28)					
Gross earnings	14,684,934	15,140,553	— 3.0	68	64
Net earnings	4,788,228	5,461,197	— 12.3		
Net balance	1,706,777	2,382,972	— 28.4		

Holding Companies

	1934	1933	Per Cent Increase	Operating Ratio 1934	Operating Ratio 1933
American Gas & Electric and subsidiaries (Year ended February 28)					
Gross earnings	$64,070,059	$63,854,851	0.3	55	53
Net balance	7,566,111	8,822,475	—14.2		
Engineers Public Service and constituent cos. (Year ended February 28)					
Gross earnings	42,487,771	45,181,589	— 5.9	67	63
Net balance	1,214,139†	1,481,878	—182.0		
Philadelphia Company and subsidiaries (Year ended January 31)					
Gross earnings	45,785,886	48,395,745	— 5.4	63	63
Net balance*	7,552,906	9,127,258	— 17.2		

*Applicable to all dividends. †Deficit.

Gross earnings—(Operating Companies) Gross operating revenue. (Holding Companies) Gross operating revenue plus other income. Net earnings—Earnings after deduction from gross earnings of operating expenses taken to include taxes, depreciation, maintenance, operating, etc. Net balance—Balance available from income for common stock dividends.

Grand Coulee Contract to Be Awarded in June

Bids called for April 20 by the United States Bureau of Reclamation on the main contract for construction of the Grand Coulee Dam and power plant on the Columbia River will be opened at Spokane, Wash., June 18. Bidders will be required to post $2,000,000 bid bond and a $5,000,000 performance bond. Work must be completed 1,650 calendar days from the date of receipt of notice to proceed. Estimated cost of the project is between $60,000,000 and $75,000,000.

Under terms of the call for bids, the government will provide all materials for the construction of the dam and power plant. The plans and specifications call for diversion of the Columbia River and construction of the huge dam and power plant, but not for the installation of equipment and machinery in the power plant. This installation work will be under a separate contract.

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Norge Adds Oil Burners

Entrance of the Norge Corporation, Detroit, into the oil burner field with a gun type model has been announced for May 1. The oil burner division will be under the sales direction of H. E. Whittingham and Ralph A. Beale. Backed by an aggressive merchandising effort, the company plans to effect national distribution of the new product in time to begin active sales effort in the fall.

New Era in Lighting Foreseen by S. G. Hibben

Predicting a new era of lighting of signal importance to the arts and decoration, Samuel G. Hibben, director of applied lighting of the Westinghouse Lamp Company, at a meeting of the American Institute held last week at the American Museum of Natural History, demonstrated the startling results produced from the various uses of colored light. The newer luminous gas lamps offer the major opportunities. Pointing out some effects already attainable with colored lights, Mr. Hibben showed how the interior decoration of homes can be changed as frequently as desired, how the beauties of paintings are intensified and how foods are made to appear more appetizing. Even black light, normally invisible, can be utilized to bring out hidden effects in our surroundings, Mr. Hibben stated.

"We will flexibly adjust and change our colors to suit our seasons or our moods," the demonstrator said. "We will exalt and glorify our dyes and pigments, and when we do we see opening before us an endless vista of progress in the artistry of color and of the generation and application of colored light. . ."

New York Metal Prices

	Apr. 17, 1934 Cents per Pound	Apr. 24, 1934 Cents per Pound
Copper, electrolytic	8.50	8.50
Lead, Am. S. & R. price	4.25	4.25
Antimony	7.95	7.95
Nickel ingot	35.00	35.00
Zinc, spot	4.75	4.75
Tin Straits	55.00	55.875
Aluminum, 99 per cent	23.30	23.30

SALES OPPORTUNITIES IN NEW CONSTRUCTION

Motors and controls, conveyors, etc., will be installed for expansion and improvements in plant of Homer Laughlin China Company, Newell, W. Va. Cost about $200,000.

Peoples Gas & Electric Company, Burlington, Iowa, plans extensions in transmission lines in part of Des Moines County. Application made for permission.

Merchants Distilling Company, Terre Haute, Ind., plans early purchase of new equipment for plant. Cost about $40,000.

Oskaloosa, Iowa, is considering new ornamental street-lighting system on portion of North First Street.

Until May 4, Signal Supply Officer, Army Base, Brooklyn, N. Y., asks bids for 30,000 ft. steel-tape-armored subterraneous telephone cable (Circular 93).

New Ulm, Minn., has authorized surveys and estimates of cost for new city-owned electric light and power plant.

Republic Distillers, Inc., Cincinnati, Ohio, recently organized, plans extensions and improvements in group of five plants at Louisville, Lawrenceburg and Burgin, Ky., and Lynchburg, Ohio, with installation of new equipment. A $1,000,000 project.

Motors and controls, regulators, electric hoists, conveyors and other equipment will be installed in new mill and at gold mining properties of California-New York Mining Company, Inc., Yreka, Calif. Fund of $375,000 is being arranged.

Board of Electric Commissioners, Quinnie District, Wallingford, Conn., has engaged Stone & Webster Engineering Corporation, Boston, Mass., to make surveys and plans for rebuilding electric power substation, recently destroyed by fire.

Until May 15, Villisca, Iowa, asks bids for equipment for city-owned electric light and power plant, including two Diesel engine-generator units and complete auxiliaries, switchboard and instruments, fuel oil tanks, etc., and for electrical distribution system. Fund of $150,000 available.

United States Engineers Office, Kansas City, Mo., asks bids until May 7 for eight 5-kva. electric generating sets, gasoline-engine-operated, with accessories (Circular 92).

Motors and controls, power substation equipment, electric hoists, conveyors, etc., will be installed in proposed refinery of Texas Potash Corporation, Dallas, Tex., in vicinity of Midland, Tex. Cost over $150,000.

Hope, Ark., plans installation of new electric generating unit and accessory equipment in city-owned power station. Fund of about $40,000 will be arranged.

Lodi, Calif., plans city-owned hydro-electric generating plant on Mokelumne River, with transmission line to city, power substation and switching station. To cost $520,000.

Sleepy Eye, Minn., plans installation of floodlighting system at local athletic field.

Until May 7, Tennessee Valley Authority, Knoxville, Tenn., asks bids for 19 steel transmission towers for Wilson Dam-Norris Dam power transmission line.

Frederick, Okla., has plans maturing for city-owned electric light and power plant. Fund of $185,000 is being arranged.

Motors and controls, regulators, conveyors, etc., will be installed to replace equipment in plant of Way Sagless Spring Company, Toronto, Ont., recently damaged by fire. Loss about $100,000. Plans being arranged for rebuilding.

Wolverine Brewing Company, Pontiac, Mich., plans new bottling plant addition. Cost about $35,000, with equipment.

Hastings, Neb., soon takes bids for equipment for city-owned electric light and power plant. Fund of $140,000 has been arranged.

Bureau of Reclamation, Denver, Colo., asks bids (no closing date stated), for eleven electric-operated traveling cranes, 4- to 30-ton capacity, each; two 4-ton jib cranes; three fixed hoists, each 3- to 5-ton capacity; two 3-ton monorail hoists for Boulder power plant. Boulder Canyon Project, Calif.-Nev. (Specification 571).

Wenso Company, Bedford, Ohio, recently organized, care of Gustave A. Mueller, 1346 Broadway, Detroit, Mich., architect, plans new local brewery, and will convert former mill of Mason Tire & Rubber Company for this purpose. Cost about $70,000.

Readlyn, Iowa, plans new electrical distribution system, with transmission line to connect with power system of Central States Power Company, which will furnish service.

Motors and controls, hoists, conveyors and other equipment will be installed in new packing plant of Saticoy Lemon Association, Albert J. Thille, Santa Paula, Calif., president, on site being purchased near Montalvo, Calif. Cost about $60,000.

Until May 8, Construction Service, Veterans' Administration, Washington, D. C., asks bids for ash conveyor system at power plant at institution at Danville, Ill.

MEN OF THE INDUSTRY

H. S. Colby Sales Manager of Combustion Engineering

Appointment of H. S. Colby as general sales manager of Combustion Engineering Company has just been announced by R. M. Gates, vice-president of that company. Mr. Colby, until recently, was president of the Air Preheater Corporation. His technical education was acquired at Cooper Union and Columbia University and for the past twenty years he has been engaged in the design, production and sales of steam generating equipment involving boilers, stokers, pulverizers, economizers and air preheaters. This background of experience and an extensive acquaintance in the field of steam generation eminently fit him for his new duties, which include direct charge of district office activities.

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J. M. Frank, president of the Ilg Electric Ventilating Company, Chicago, was elected president of the National Association of Fan Manufacturers at a recent meeting held in Detroit.

Lewis W. Baer, formerly service manager of the West Penn Appliance Company, has been transferred to the West Penn Power Company as supervisor of all commercial and domestic customer service. In this position Mr. Baer is responsible for the development of service routines and methods.

Olaf Laurgaard, for sixteen years city engineer of Portland, Ore., and since Jan. 1 in consulting civil engineering practice in that city, has been selected by the Bureau of Reclamation to be construction engineer of Parker Dam for the Metropolitan Water District of southern California on the Colorado River near Parker, Ariz. Following graduation from the University of Wisconsin in 1903, he entered the reclamation service, going to Portland in 1905. He was engaged in design and construction of reclamation projects and later of private power projects until he was appointed city engineer of Portland in 1917. Mr. Laurgaard is past-president of the National Council of State Boards of Engineering Examiners and is chairman of the convention committee of that organization which will convene in Portland in October of this year.

Clyde L. Chamblin, proprietor of the California Electrical Construction Company, has been made a director of the San Francisco Retail Merchants Association, representing the electrical business for the year 1934. Mr. Chamblin has been prominently identified with the electrical industry in northern California, for a number of years.

Dr. John B. Whitehead, dean of the faculty of engineering of Johns Hopkins University and president of the American Institute of Electrical Engineers, has been awarded a medallion by the Advertising Club of Baltimore for the work he performed last year in dielectric and cable researches. A medallion is given by the club each year to the Baltimorean making the most important contribution to the advancement of science.

J. W. Peterson, for 38 years superintendent of the Fergus Falls, Minn., electric light department, has retired. A pioneer in the electrical industry, Mr. Peterson started in 1884 with the Swan-Brush Electric Company of Minneapolis and after five years of service left for Eau Claire, Wis., to aid in the installation of one of the first street car systems in the northwest. When the work was completed he took charge of the power house. It was in 1890 that he became identified with the undertaking at Fergus Falls, where he rebuilt the electrical system.

Arthur Halsted, for fourteen years with the U. S. Bureau of Standards, has been appointed a member of the staff of the American Standards Association with headquarters in Washington. Mr. Halsted was graduated from the Case School of Applied Science, Cleveland, in 1908. His work has been in the electrical field, particularly in connection with the National Electrical Safety Code, National Electrical Code and government specifications and tests. He has served as a member of several American Standards Association sectional committees in connection with his work with the Bureau of Standards and is a member of several technical societies.

J. A. Longley Appointed to General Managership

J. A. Longley, for the past four and a half years vice-president and assistant general manager of the Tennessee Electric Power Company, was elected vice-president and general manager of that utility at a recent meeting of the board of directors. J. C. Guild, Jr., president, had previously held also the position of general manager. Mr. Longley has been associated with Tennessee Electric Power and its predecessors for the past twenty years.

He began his business career in the steam heating field, after leaving the Massachusetts Institute of Technology at Boston, later engaging in mining engineering work in Arizona. His first connection with the electrical industry was at Portland, Ore., in 1910, and after working on the relocation and construction of a steam power plant in Columbus, Ohio, just after the Dayton flood, he moved to Nashville to engage in construction work at the Nashville steam plant of the Nashville Railway & Light Company, transferring his interests to Chattanooga in 1914 as assistant superintendent of the Tennessee Power Company. He advanced to the general superintendency and, on the formation of the Tennessee Electric Power Company in 1922, became manager of its production and transmission department in charge of all power plants, substations and transmission lines. In 1928 he was appointed assistant to the general manager and three years later was elected to a vice-presidency.

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Robert O. Brannan, for the past four years secretary and treasurer of the Danforth Refrigeration Company, is now devoting all his time to air-

conditioning activities of the Cleveland Electric Illuminating Company. Prior to Mr. Brannan's entrance into the local refrigeration field he was for several years identified with the heating and ventilating industry in Chicago, and the combined experiences have given him an excellent background for his present work.

HAROLD W. ROSS, formerly chief accountant for the Missouri Public Service Commission, has joined the staff of the Union Electric Light & Power Company, St. Louis.

OBITUARY

E. D. Alexander

E. D. Alexander, president of the Illinois Northern Utilities Company, Dixon, Ill., died April 21 at Rochester, Minn., following an emergency operation. He was 73 years of age. Joining the Englewood Electric Company in Chicago in 1890, he was made vice-president and general manager five years later and when the Commonwealth Electric Company took over the Englewood company in 1898 he became superintendent of the southern district for Commonwealth and later for its successor, the Commonwealth Edison Company. From 1909 to 1913 he served as secretary and treasurer of the North Shore Electric Company, a part of the Public Service Company of Northern Illinois, resigning to go to Dixon as assistant to the president of the Illinois Northern Utilities Company. In 1924 he became vice-president of that utility and in 1930 president.

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JOHN J. FARLEY, associate rates examiner on the New York Public Service Commission, died suddenly March 16. Mr. Farley had been connected with the commission and its predecessor, the old Railroad Commission, for more than thirty years.

C. B. BUCHANAN, vice-president of the Worcester (Mass.) Street Railway Company and formerly vice-president and general manager of the Virginia Railway & Power Company, Richmond, died suddenly in Worcester April 20. Mr. Buchanan was prominently identified with the electric traction industry as a consulting engineer. After leaving Richmond in 1922 he became associated with the Boston Street Railway and subsequently spent ten years in New York, where he established a consulting engineering practice.

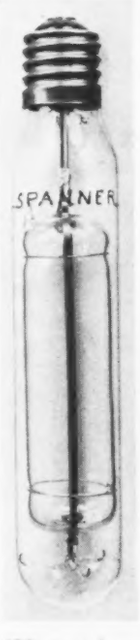
DR. PAUL S. SUSSAN, optometrist and electrical engineer, died April 17 at his home in New York in his fifty-fourth year. Born in Riga, Latvia, Dr. Sussan was graduated as an electrical engineer in Germany and came to this country in 1904, becoming an engineer for the General Electric Company in Schenectady. Later he was associated with the New York Edison Company. While working for the Edison company Dr. Sussan studied at the Columbia University School of Optometry, from which he was graduated in 1924. Thereafter he practiced in this field.

HARVEY C. POND, a vice-president of the Arrow-Hart & Hegeman Electric Company, Hartford, Conn., died of heart failure at the age of 47, April 12, at Tampa, Fla., while away on a business trip. Mr. Pond began his business career with the Arrow Electric Company of Hartford when it was one of the city's young but rapidly growing industries in 1909. He soon became sales manager and was made general sales manager under the merger of that company and the Hart & Hegeman Manufacturing Company in 1929. Within a short time he was elected to the board of directors of the Arrow-Hart & Hegeman Electric Company, and to be vice-president in charge of its sales.

FREDERICK L. WALTER, for several years sales manager of the American Steel & Wire Corporation of New York, died suddenly, April 2, at his home in Hasbrouck Heights, N. J. He was 46 years of age.

NEW EQUIPMENT

Mercury 110-Volt Lamps Available in Four Sizes



High-pressure mercury vapor lamps to operate on standard 110-volt circuits are announced by the Spanner Vapor Lamp Company, Inc., 308 West 231st Street, New York, in four sizes: 100, 200, 300, and 400 watts. They will operate in any position. The 400-watt size illustrated has an over-all length of approximately 11 in. and has a 6-in. light-giving tube within a T-16 tipless bulb, 2 in. in diameter. The smallest lamp has an over-all length of 5½ in. and outer diameter of 1¼ in. The over-all efficency, including series reactor, of the 400-watt lamp is 40 lumens per watt by test and for other sizes this will drop off to approximately 25 lumens for the smallest size. These lamps are suitable for street, flood or other commercial and industrial lighting. Lamps for 220-volt service, similar to those used in Europe, are also available in the above wattages.

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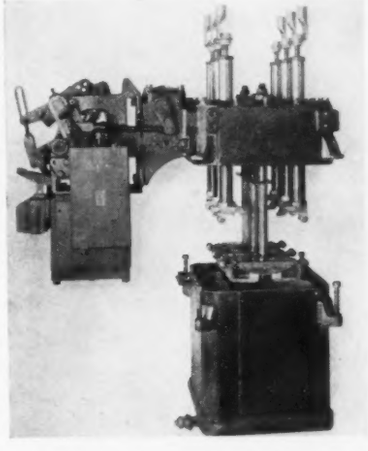
MODERN INDIRECT LIGHTING FIXTURES for use with the new three-light lamps have been announced by the Curtis Lighting Company, 1119 W. Jackson Boulevard, Chicago. Included in this series of fixtures are luminaires with chain or rod hangers in a wide variety of finishes. For commercial interiors units are finished in brushed silvertone, satin silver or satin aluminum. Several luminaires of louvered construction are offered for the conventional type of general illumination as well.

Oil Breakers for Indoors

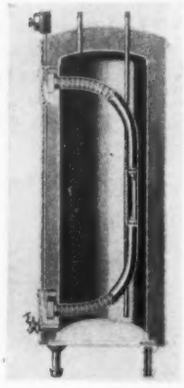
Indoor oil circuit breakers, type ED-20, for either standard or reverse frame mounting, have been introduced by the Condit Electrical Manufacturing Corporation, Boston, Mass. This type has all poles in one tank, high-speed inclosed mechanism and sturdy frame construction with deep overhanging flange. Oversize one-piece "Bakelain" bushings,



laminated brushes protected by exceptionally heavy arcing contacts of large thermal absorption capacity and heavy steel plate tank with full length lining and barriers between phases are out-

standing features. Type ED-20 breakers are furnished for 600 amp. at 15,000 volts, 1,200 amp. at 7,500 volts and 2,000 amp. at 5,000 volts, all with an interrupting capacity rating of 50,000 kva.

Water Heaters Designed for Economy, Long Life



Characterized as developed by power company engineers to meet power company conditions, the "Detroit" electric water heater is announced by the Efficient Devices Company, 1461 Calvert Avenue, Detroit, Mich. Among the features of the heater are a heavily galvanized copper bearing steel tank, with Everdur or copper optional; granulated cork insulation, open-type elements quickly removable and operating at low surface temperatures, easily adjusted and simply operating thermostat and adjustable legs with sliding caps. It may be used either for continuous or controlled service and is said to be a proven no-trouble device. The heater is low in price and is available within a wide range of specifications modified to fit local conditions as may be desired by buyers.

Heat Insulation Improved

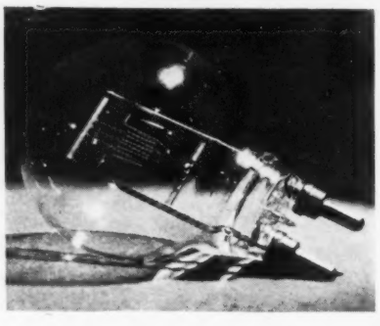
Plastic heat insulation of a new type, using as an insulating aggregate an expanded, non-metallic, micaceous material of extreme lightness in weight and high insulating values, was recently introduced by the Wyolite Insulating Products Company, a division of the Wyodak Chemical Company of Cleveland. The insulation has proved most efficient in the insulation of boilers and boiler room equipment and on roofs of annealing or heat-treating electric furnaces, as well as open hearth and other types. Combined with a specially processed, highly tenacious binder, the plastic insulation has a coverage of 1,400 sq.ft. to the ton when applied one inch thick. The material adheres firmly to any surface, metal or brick, and forms an unbroken covering over an entire heater surface. Its conductivity, at a mean temperature of 200 deg. F., is 1.0; volume shrinkage between wet and dry state is 10 per cent. The average weight of the insulation applied is about 16 lb. to the cubic foot. It functions efficiently up to 1,700 deg. F. and is reclaimable from installations where the temperature has not exceeded 1,200 deg.

Shielded-Arc Electrodes for High-Tensile Steels

Welds with tensile strengths of 85,000 to 100,000 lb. per square inch can be made with the new arc-welding electrode, "Shield-Arc Eighty-Five," just announced by the Lincoln Electric Company, Cleveland, Ohio. This electrode is designed especially for use on high-tensile steels. Here it provides welds with tensile strength of 85,000 to 100,000 and unusually high ductility; from 15 per cent to 20 per cent elongation in 2 in. Shield-Arc Eighty-Five is particularly suitable for the welding of those low alloy structural steels which, on normalizing, have tensile strengths under 100,000 lb. per square inch; for example, Cromansil, low carbon nickel steels, structural silicon steels, low carbon manganese steels, vanadium steels, and, in general, all low alloy steels, under 0.30 per cent carbon. The new electrode is suitable for flat, vertical and overhead welding and is available in 5/32-in. and $\frac{3}{16}$-in. sizes. For most vertical and overhead welding the 5/32-in. size is preferred; however, for vertical welds in thick plate $\frac{3}{16}$ in. may be used.

Bi-Post 2,000-Watt Lamps

More rugged lamps in the 2,000-watt size are to be made available, according to the announcement of the Incandescent Lamp Department of the General Electric Company, Nela Park, Cleveland.



The new bi-post base construction has been adapted to 115-volt lamps of this size employing G-48 lamp bulbs. The application of the bi-post design principle to this popular motion-picture studio and spotlight lamp insures not only a more rugged lamp but one in which the relative position of the base and light source is determined entirely by the limits of metal working accuracy. The maximum over-all length, from shoulder to prong to center of filament, is 5 in., and the bulbs have a life of 200 hours.

ENGINEERING DATA FROM MANUFACTURERS

Bulletins and catalogs now available to engineers by manufacturers and associations

ELECTRIC HEATING UNITS AND DEVICES for small heating jobs, Bulletin GEA-1520B of the General Electric Company, Schenectady, N. Y., 50 pages, February, 1934. Lists prices of G.E. small heating units and devices and their control equipment; has brief illustrated descriptions of 24 installations and other useful electric heating information.

CHROMALOX heating units, Catalog 34 of the Edwin L. Wiegand Company, Pittsburgh, Pa., 60 pages, March, 1934. Applications, illustrations and listing with prices of the Chromalox heating units, together with instructions, tables, curves, charts and calculators, which will help in selecting proper equipment for particular needs.

THE TREND TOWARD WOOD CONDUIT, a booklet of the Southern Wood Preserving Company, Dollar Savings & Trust Building, Pittsburgh, Pa., eight pages, March, 1934. History of wood conduit and present day application and advantages, with drawings and illustrations.

LINK-BELT General Catalog 600 of the Link-Belt Company, Chicago, Ill., 1,024 pages, April 1, 1934. Illustrates and gives prices of such of the company's products as can be purchased on a list and discount basis, and gives engineering and dimensional data helpful to engineer and buyer.

ANACONDA WELDING RODS for gas and electric welding, a booklet of the American Brass Company, Waterbury, Conn., sixteen pages, April, 1934. Detailed information on the welding properties and physical properties of Anaconda welding rods, together with illustrated descriptions of the various methods of welding to which they can be applied.

INSTALLING GENERAL CABLE TRENCHLAY, Bulletin of the General Cable Corporation, 420 Lexington Avenue, New York, twelve pages. Recommended methods for the handling and protection of all types of low-voltage, trenchlay (non-metallic sheathed) cables.

SUPERVISORY CONTROL, Bulletin C 1983 of the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., ten pages. Description of Westinghouse two-wire visicode and audicode supervisory control, which is a simplified and certains means of getting remote indications of apparatus units and especially applicable for railway, central station, substation, and oil and gas pump line operation.

BRACKET BEARING SYNCHRONOUS MOTORS, Bulletin 1165, of the Allis-Chalmers Manufacturing Company, Milwaukee, Wis., sixteen pages. Treats of the standard line of motors for general requirements and also special construction features, such as anti-friction bearings, inclosed fan-cooled types, and vertical motors. Synchronous motors for power-factor improvement are also discussed and graphical methods for figuring corrections.